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# WEST Search History

DATE: Monday, December 23, 2002

<u>Set Name</u>	<u>Query</u>	<u>Hit Count</u>	<u>Set Name</u>
side by side		result set	
<i>DB=USPT; PLUR=YES; OP=OR</i>			
L21	L20 and 119	40	L21
L20	foreign near7 (company or carrier or network or system)	7533	L20
L19	L18 and 117	165	L19
L18	home near7 (company or carrier or system or network)	18641	L18
L17	L16 and 115	263	L17
L16	central or host\$ or administrator	879303	L16
L15	L14 and 16	438	L15
L14	L13 and 112	1130	L14
L13	(bill\$ or call\$ or subscriber) near7 (record or report or information)	46791	L13
L12	(telephone or phone or mobile or cell or cellular) near7 roam\$	1694	L12
L11	L10 and 19	110	L11
L10	bill or report	163197	L10
L9	L8 and 16	264	L9
L8	(telephone\$ or phone\$) near7 roam\$	641	L8
L7	L6 and 15	0	L7
L6	@ad<19960521	2312243	L6
L5	(internet or world near4 web) near7 roam\$	38	L5
L4	5416842.pn.	1	L4
L3	5623601.pn.	1	L3
L2	5696901.pn.	1	L2
L1	5898780.pn.	1	L1

END OF SEARCH HISTORY

Set	Items	Description
S1	8325248	PD<960521
S2	27912	(INTERNET OR NETWORK? OR WORLD (4N) WEB) (9N) ROAM?
S3	1015	S1 AND S2
S4	4987	INTERNET (5N) ROAM?
S5	20	S4 AND S1

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L11: Entry 11 of 110

File: USPT

Feb 23, 1999

DOCUMENT-IDENTIFIER: US 5875238 A

TITLE: Transport mechanism for accounting messages within a telecommunications system

DATE FILED (1):  
19951221

Brief Summary Text (5):

Developments and improvements in wireless telecommunications switching systems have allowed wireless users to easily move from one physical location to another and still access and utilize the user's own telephone services and subscriber features. One example of this type of service is roaming. Roaming allows the subscriber to move from one city covered by a first telephone company to another city covered by a second telephone company and still use his or her cellular telephone unit. Currently, telephone services toward a roaming subscriber are allowed after the second telephone company requests and receives confirmation data regarding the roaming subscriber's service from the first telephone company. After services have been provided to the roaming subscriber, the second telephone company collects the charging data and sends the information, usually in a batch file, to a centralized administrative center for further analysis. It is at this point that the rightful owner or the centralized billing administrative system determines illegal use of the service by a clone. Since the transfer of the billing batch file is usually done a few days after the actual services have been provided to the roaming subscriber, there is an undesirable time delay before possible fraud is detected.

Detailed Description Text (7):

FIG. 3 is a block diagram of how billing records are generated and consolidated when a mobile station uses more than one local exchange during roaming. When a MS 80, assigned to home MSC 40A, tries to use its telephone service while roaming in an area covered by another local exchange 10C served by a visited MSC 40B, the visited MSC 40B requests validation and subscriber data information from the home switch 10A via PSTN comprising transit exchanges 90. The home switch 10A, in turn, updates the HLR 40A and sends the necessary data back to the visited MSC 40B via the same PSTN comprising transit exchanges 90. Once the MS 80 completes a call to another subscriber such as a subscriber 90 connected to yet another local exchange 10, Call Detail Records (CDRs) are produced by the visited MSC 40B. The CDRs are then sent off to a centralized administrative center 140 for further processing where other CDRs are also received from other local exchanges and consolidated bills 150 are generated for each individual subscriber. These CDRs are usually produced and outputted to magnetic tape 120 by charging subsystems (CHS) 100 and file management subsystems (FMS) 100 within the local exchanges 10A and 10C and physically delivered to the Administrative center 140 via magnetic tapes 120.

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L21: Entry 2 of 40

File: USPT

Jan 11, 2000

DOCUMENT-IDENTIFIER: US 6014557 A

TITLE: Apparatus and methods for providing wireless system fraud and visibility data

DATE FILED (1):19960314Abstract Text (1):

Apparatus and methods are disclosed for providing wireless telecommunications service providers roamer visibility for on-line customer support and a fraud data feed for reducing losses due to fraud, obviating the need for each provider to purchase data from a central clearinghouse. Monitoring devices are coupled to existing network links (e.g., SS7 telecommunications links) or network elements (e.g., an STP pair), and are adapted to capture certain data regarding user traffic. The captured data is in turn provided via a wide area network or other transmission means to a message processor. The message processor collates raw messages received from the data capture devices and produces roamer visibility and fraud data. This subscriber-related data can be used to populate one or more databases available for query by on-line client workstations, or may, in the case of fraud-related data, be provided as a wire feed or other transmission to a fraud detection system or other wireless service providers. Before providing fraud data, redundant data is eliminated.

Brief Summary Text (5):

Conventional wireless telecommunication systems employ numerous independent cellsites ("cells"). Each cell covers a designated geographic area and is connected via a dedicated network (usually leased lines or microwave) to a Mobile Switching Center ("MSC") that is in turn connected to the Public Switched Telephone Network ("PSTN"). The MSC handles all call processing intelligence, switching functionality, fault detection and diagnostics. MSCs are also integral to the operation of recently developed Personal Communication Systems ("PCSS"), another type of wireless system. A PCS utilizes numerous "microcells" that blanket a high use area, or an area where terrain features limit transmission capabilities (e.g., a downtown office district with tall buildings.) Because of the greater number of cells, the PCS can handle a significantly greater volume of traffic. Located within each PCS microcell is a low power transmitter. After receiving the subscriber's signal, the low power transmitter communicates (normally via microwave, PSTN, or data lines) with a controller. The controller, in turn, communicates with the MSC. Each PCS or cellular network covers only a specified "home" geographic area. Consequently, as the mobile user moves out of the home area and into a "foreign" area, telecommunications service is provided by a "foreign" wireless service provider typically not associated with the user's home wireless service provider. Operation in a foreign area is known as "roaming."

Brief Summary Text (7):

The fees associated with the use of network services provided by third parties, which may be charged on a per transaction basis, lead to higher consumer prices for wireless communications services. The cost of paying network providers to operate a SS7 or other network, and the consumer prices they result in, may represent a serious constraint on wireless growth. An additional impediment to growth in the market for wireless services is the absence of a seamless roaming environment. In a seamless roaming environment, enhanced communications services are provided to mobile subscribers as they move about the nation (or, more optimistically, through various parts of the world), without diminution in service as one crosses boundaries between service providers.

Brief Summary Text (11) :

Two types of fraud are prevalent. One is "cloning fraud," in which a valid customer's mobile identification number ("MIN") and/or electronic serial number ("ESN") are "cloned" or copied into another cellular set. Most typically, cloning fraud is perpetrated in a foreign service provider's network. Even when the fraud occurs outside of the home service provider's network, the home service provider remains liable for the fraud, the costs of which directly diminish the service provider's revenue.

Brief Summary Text (12) :

A second typical fraud problem involves subscribers who are not entitled to service (e.g., because they have failed to pay their bills or obtained service under false identities, etc.), but who nevertheless attempt to obtain roaming service in a foreign service provider's wireless system. Roaming involves a validation process to determine if the roamer is legitimate in its home system. The switches of systems located geographically close to one another are often coupled because those systems' customers will frequently roam into the adjacent area. These systems can directly communicate with one another to exchange validation requests and fraud control data. In any event, even if some switches of different systems were coupled, those switches may nevertheless be unable to communicate with one another to exchange validation requests and fraud control data for the simple reason that the switches may be incompatible with one another. As a result, a national clearinghouse system for handling fraud and roamer management has arisen.

Brief Summary Text (13) :

A national clearinghouse typically has a database containing so called "negative files" including lists of stolen phones and cloned MINs. The typical clearinghouse also couples to the MSCs of subscribing systems in order to access subscriber data, usually called the HLR or Home Location Register, to validate subscribers for whom services are being requested in a foreign market whose service provider is also a member of the clearinghouse network. A national clearinghouse is capable of providing on-line support as well as a data feed. The clearinghouse validates customers prior to allowing a request for telecommunications service to proceed. But by the time the clearinghouse checks its own database and then, if necessary, the database of the subscriber's carrier, the foreign carrier may already have permitted a fraudulent roaming communication to occur.

Brief Summary Text (14) :

In order to detect "cloning fraud," a service provider may use, among other methods, a fraud management system that develops usage profiles. These profiles are based on the communications traffic information for particular customers and are obtained from billing records and other sources. If a call does not match the customer's profile, an analyst may contact the customer. A fraud detection system (like CloneDetector available from GTE TSI (Telecommunications Services Inc.)) analyzes calling patterns to identify calls made close in time using identical MINs in widely-separated geographical areas. This type of condition generally indicates that one of the MINs is a clone. The customer corresponding to the MIN is contacted for confirmation and appropriate steps are taken to lock the clone out of the system.

Brief Summary Text (15) :

Some clearinghouses are presently attempting to offer both fraud detection systems and customer on-line support systems intended to react in real time. Clearinghouses charge each subscribing service provider a per-transaction fee for providing fraud management services and also charge for certain on-line support data. In addition to charging transaction fees, clearinghouses incorporate each subscribing service provider's valuable and commercially sensitive customer information into a central pool within its exclusive control. Clearinghouses provide needed roamer visibility. But subscribing service providers lose the ability to obtain data on their own network transactions if they choose not to utilize the clearinghouses for validation for particular transactions if they choose not to utilize the clearinghouses for validating particular transactions. Data of this sort is critical, not only for network operation, but also for purposes of planning and marketing. Understandably, subscribing service providers also prefer to maintain control over their own customer profile and system traffic information. They thus prefer to eliminate the clearinghouse service and directly manage user validation for their own networks in

order to eliminate the transaction fees charged by the clearinghouses and obtain their own on-line support data.

Brief Summary Text (16) :

Subscribing service providers can circumvent the clearinghouse services by networking their switches with switches in foreign service providers' systems. This process is facilitated by deployment of SS7 networks, coupled with the advent of IS-41. IS-41 is an interim standard created by the Electronic Industry Association/Telecommunications Industry Association ("EIA/TIA") that permits switches produced by different manufacturers to communicate with one another. IS-41 enables the switch of a home system of a roaming subscriber to communicate with a foreign system providing services to the roaming subscriber in order to transmit validation and customer profile information. IS-41 messages may be transported over SS7 networks that many service providers are already connected with or soon will be deploying. Other standards may be developed and will likely also be capable of transmission over SS7 networks. Using such standard message formats and protocols, switches belonging to differing service providers become capable of requesting validation data and exchanging customer profile information. This information sharing not only eliminates the high transaction charges associated with a national clearinghouse, but it also returns control of valuable, proprietary customer profile information to the service providers.

Brief Summary Text (35) :

Generally, the message processor may be centrally located and in communication with various data capture devices via a LAN, WAN or equivalent communication path. Central location allows for easier changes to the functionality implemented by the message processor. Nevertheless, the message processor may also be deployed with and connected directly to each data capture device. This would free up valuable system bandwidth since raw, unprocessed messages will not be sent, as is the case with a centrally located message processor.

Brief Summary Text (41) :

It is a further object of the present invention to provide captured data to an administrative facility, such as a central message processor, where the results are collated or otherwise processed to yield roamer visibility, fraud, or other data useful in the administration of a wireless system.

Brief Summary Text (43) :

It is another object of the present invention to provide a central message processor including a database containing roamer visibility data available for query by one or more on-line customer support systems.

Brief Summary Text (44) :

It is a further object of the present invention to provide methods and apparatus for providing a central message processor for processing captured messages as well as fraud data received from outside or third party providers to generate a fraud data feed from which redundant fraud-related information has been removed.

Drawing Description Text (12) :

FIG. 8 is a flowchart illustrating at a high level of abstraction the logic flow of the processing performed by a central message processor illustrated in FIG. 1-3.

Detailed Description Text (5) :

Various embodiments of data capture devices 30 are shown in FIGS. 1 and 2. Thus, link capture device 32, STP capture device 34 and switch capture device 36 each comprise a data capture device 30. Each can identify messages of interest out of a number of signals indicative of wireless traffic over a wireless telecommunications system. Output from a particular data capture device 30 is forwarded to a central message processor 50 by any suitable means for transporting digital data. For example, but without limitation, data retrieved and processed by link capture device 32 may be made available on a local area network (LAN), such as an Ethernet LAN, or over a corporate wide-area-network (WAN) 40, as illustrated in FIG. 1, to the central message processor 50.

Detailed Description Text (15) :

Generally, changing to a different message set is done simply by identifying which set

of messages is to be captured and informing data capture device 30 of that set by software exchange (e.g., by providing a system disk or modem upload of the new message set of interest.) Also, if the invention is implemented with other than an IS-41 standard in place, messages analogous to those listed above could be gathered by data capture device 30. In any event, a set of captured and identified messages may be formatted into TCP/IP packets, as seen in FIGS. 7A-7C, and forwarded to central message processor 50 for further processing.

Detailed Description Text (16):

The central message processor 50 is preferably a facility for receiving data handled at a plurality of switches (not shown) and captured by corresponding data capture devices 30 similar or identical in function to link capture device 32, STP capture device 34 or switch capture device 36. IS-41 (or other) messages captured from SS7 links at switches 10 by these data capture devices 30 may be provided to the central message processor 50 via any suitable means, but in the preferred embodiment are sent in packets over a WAN 40 running the TCP/IP protocol. Central message processor 50 aggregates, stores, and processes the received IS-41 messages in order to provide coordinated customer-related visibility and fraud data, as will be described in detail below.

Detailed Description Text (17):

Messages captured by data capture device 30, and processed by central message processor 50 to yield useful data for visibility and fraud analysis, can be made available for query by one or more client customer on-line stations (several of which are indicated by reference numerals 60, 62 and 64) via WAN 40. These customer on-line stations are thereby provided with visibility data for roaming wireless service subscribers, enabling on-line customer service representatives (operating on-line stations 60, 62, 64, etc.) to provide quick, high quality and responsive service to subscribers of (or roamers using) the wireless system. Furthermore, fraud data in the form of a roamer registration feed culled from each switch, of which switch 10 is a single example, may be processed by captured data processing device 50 and provided to a fraud detection system 80 via an appropriate link 68.

Detailed Description Text (18):

FIG. 2 illustrates representative data flows between components of the embodiment shown in FIG. 1. Link capture device 32 monitors each link to which it is coupled for any message that belongs to a set of IS-41 message types useful for customer on-line support and fraud data feed purposes. In FIG. 2, N link capture devices 32.sub.1, 32.sub.2, 32.sub.3, through 32.sub.N, each receive a corresponding feed from an SS7 link for a particular switch. Also, STP capture device 34 receives a captured data feed from a pair of STPs 24 and 26 and switch capture device 36 receives a captured data feed from AT&T switch 11 that operates via the proprietary EFTN protocol. As described in connection with FIGS. 3-6, the link capture devices 32.sub.1-N, STP capture device 34 and switch capture device 36 each retrieve IS-41 messages and format the messages into packets (one format for which is described in connection with FIGS. 7A-7C, below.) The resulting packets are transmitted to the central message processor 50 via an appropriate transmission means, such as a corporate WAN 40 supporting the TCP/IP protocol, or other suitable path.

Detailed Description Text (19):

For example, but without limitation, the central message processor 50 may be implemented by a Hewlett Packard HP 9000 K400. The central message processor 50 preferably includes a subprocessor corresponding to each link capture device 32.sub.1-N, STP capture device 34 and switch capture device 36 for receiving and processing received IS-41 message packets. Each of the subprocessors of central message processor 50 preferably runs in parallel a set of message pairing and processing procedures 120.sub.1-N, each corresponding to the message feed received from a particular data capture device 30 over WAN 40. The operations of these procedures are discussed below in connection with FIGS. 8-10.

Detailed Description Text (22):

IS-41 messages typically contain information regarding the origination and timing of message generation. Thereby, the central message processor 50 can process paired message (and expired invoked messages) to sort them by day and occurrence of call. Sorted message are then indexed, segmented by date and stored in the database 150.

Database 150 thus provides comprehensive visibility data available for query according to known techniques by customer on-line workstations, e.g., workstations 60, 62, and 64.

Detailed Description Text (30) :

Upon the occurrence of a periodic interrupt, operating system 112 initiates a real time decoder process 114, the logic for an embodiment of which is provided in FIGS. 6A and 6B. In the period between interrupts, many IS-41 messages may have been received by the link interfaces 102-108 and temporarily stored in the link message buffer 110. The periodic interrupt permits the real-time decoder process 114 to retrieve captured IS-41 messages from the link message buffer 110 for processing and transmission to central message processor 50, as described in connection with FIGS. 6A and 6B.

Detailed Description Text (32) :

Because STPs are paired, related messages could come across different STPs. Thus, for example, an IS-41 invoke message could come across STP 24 and its corresponding IS-41 return result message could come across STP 26. Message traffic captured from each STP 24, 26 is merged via a merge catcher process 46 that may reside on STP merge processor 35, which may be implemented with an HP K 400. This ensures that all messages of interest are combined for forwarding by message data communication process 48 to the central message processor 50. The message communication process 48 implements the real-time message decoder 114 process shown in FIGS. 6A and 6B and described below. Generally, this process formats and sends received messages to the central message processor 50.

Detailed Description Text (33) :

To central message processor 50, the data feed flowing from STP capture device 34 is just like any other data feed from any other data capture device 30. Thus, processing of data captured from STP pair 24, 26 proceeds as described generally above and in more detail in text associated with FIGS. 8-11.

Detailed Description Text (36) :

Components of switch capture device 36, (e.g., MV client process 54, storage 55 or message communication process 56) may reside on central message processor 50 to maintain transparency across the system. Formatted messages are stored in a file within central message processor 50 so that the processing portions can parse the file and obtain the stored messages. (Message communication process 56 has the same functionality as message communication process 48 described in FIG. 4.) To the message processing portions of the central message processor 50, messages received from switch capture device 36 are the same as messages received from other data capture devices 30 and processed in the same fashion.

Detailed Description Text (41) :

A real time decoder ("RTD") process 114 is entered at 120 by a function call. Each function call processes a single IS-41 message stored in the link message buffer 110, preferably the earliest received message consistent with FIFO principles. Processed messages are transmitted over WAN 40 from data capture device 30 to central message processor 50. As shown in FIG. 6A, following entry into RTD process 114 at step 120, condition check 122 determines whether a delay timer has expired.

Detailed Description Text (44) :

If condition check 122 instead reveals that the delay timer has expired, RTD process 114 determines (according to known methods) at step 124 whether the data capture device 30 had an established TCP/IP connection with central message processor 50 across WAN 40. If no such connection established, RTD processor 114 at step 126 initializes a socket open process and attempts to set up a TCP/IP connection with the central message processor 50 over the WAN 40. The RTD process 114 at step 128 checks for a successful attempt to set up a TCP/IP connection. If not, the delay timer is set at step 129, the current message is logged at step 154 (FIG. 6B) in the circular buffer, and control is restored to operating system 112.

Detailed Description Text (46) :

Messages of interest are formatted (as shown at step 154 in FIGS. 7A-7C and described below) and held for transmission. Then, or if condition check 128 confirms an established TCP/IP connection, the RTD process 114 checks at step 132 whether any

- messages are in the circular buffer, which holds messages unsent due to lack of a network connection with central message processor 50. RTD process 114 at step 134 attempts to send the next message available in the circular buffer over the WAN 40 to the central message processor 50. Send check 136 determines if the transmission attempt of step 134 was not satisfactory; if not, then the message is left in its location in the circular buffer and retrieved for sending at a later time. On the other hand, after a successful transmission at step 134, RTD process 114 checks whether either all messages in the circular buffer have been sent (i.e., the buffer has been flushed) or a pre-set maximum number of messages from the circular buffer have been sent. Transmission continues until either condition is met.

Detailed Description Text (47):

After step 138 determines all or a pre-set number of messages were sent, then (referring to FIG. 6B) RTD process 114 checks at step 140 for an incoming message, like one from an operator or from central message processor 50. If a message has been received (e.g., at a TCP/IP socket over WAN 40), host process step 142 processes it. For example, the host could send any of multiple messages including: (i) a shutdown message; (ii) a shutdown response or (iii) an error message. Shutdown messages request the link capture device 32 to close connections and properly store all data received but not yet transmitted upon receipt of a shutdown request. Link capture device 32 also can request shutdown. In that case, the shutdown response from central message processor 50 acknowledges and authorizes shutdown. Error messages simply indicate a system error. They are logged so that the time and date of the error is tracked for later analysis.

Detailed Description Text (48):

Shutdown check step 144 determines if the processed message indicates that a shutdown of a data capture device 30 has been ordered. (A shutdown message may be sent, for example, if a link capture device 32 is to be removed from service for maintenance or other reasons.) Shutdown results in closing the TCP/IP connection at step 146, and setting the delay timer at step 148. The message is logged in a file, and control returns to the operating system 112. According to the described logic, graceful shutdown can thereby be achieved, since any data currently being handled is retrievably stored, avoiding its loss. To facilitate an operator (of the data capture device 30 or central message processor 50) in removing the device from service without the central message processor 50 failing to be notified, data capture device 20 may optionally include a "hotkey." The "hockey" prompts an operator of the data capture device 20 for confirmation of a command to shutdown communication and would forward a message to central message processor 50 if confirmation were received.

Detailed Description Text (50):

In the absence of a shutdown message, then at step 154 RTD process 114 attempts to send the current message over the WAN 40 to the central message processor 50. Control returns to the operating system 112 whether the message was successfully sent or not successfully sent (in which case it is subsequently logged in the circular file at step 150).

Detailed Description Text (55):

Referring again to FIG. 1, data capture devices 30 are coupled to the central message processor 50 by a suitable data transmission medium like, for example, the WAN 40. Central message processor 50 can communicate by way of the WAN 40 to one or more customer on-line stations 60, 62, and 64 or to the fraud detection system 70.

Detailed Description Text (56):

Central message processor 50 preferably may receive, aggregate and route input from a number of data capture devices 30 or analogous devices. Central message processor 50 may be implemented by any processing device having sufficient input/output channels and processing capacity for performing the operations described below, and running any suitable operating system. For example, central message processor 50 may be an HP-840, manufactured by Hewlett-Packard Co. and running the UNIX operating system, HP-UX 10.0. Alternatively, the central message processor 50 may be an HP 9000 H40, also manufactured by Hewlett Packard Co. (Any workstation programmed/configured according to the present invention could conceivably perform as the central message processor 50 depending on the volume of records and number of users.)

Detailed Description Text (57) :

FIG. 2 describes the functionality and data flows associated with central message processor 50 regardless of the platform used to implement it. FIGS. 8-11 illustrate the logic flows associated with processes implemented by central message processor 50 for carrying out its functions.

Detailed Description Text (58) :

FIG. 8 illustrates the logic flow for a high level loop 200 implemented by central message processor 50. Since the primary function of the central message processor 50 is to collect data sent to it by a plurality of data capture devices 30, the central message processor 50 devotes a portion of its attention to monitoring input received at its ports. To this end, it implements server functionality for interfacing with an application program running on a remote client system. The interfacing functionality may be implemented, for example and without limitation, by the TCP/IP Sockets API (application programming interface). The Sockets API may be used to implement a client-server relationship between two application programs running in different computing environments, such as between data capture devices 30 and central message processor 50. The Sockets API can permit access to protocols other than TCP/IP.

Detailed Description Text (60) :

Logic flow associated with the process sockets routine 300 is shown in FIG. 9. Generally, there are many socket child processes, which initialize in order to handle each connection request from particular data capture devices 30. Initially, an event log file is opened at 302 and an error log file is opened at 304. These files are used for general debugging and maintenance activities. For example, the event log file may be used for informational messages like open, close, shutdown, etc. The error log records warnings and system errors. At 306 the process waits for connection requests from a number (1, . . . , N) of data capture devices 30 that are essentially clients served by the central message processor 50. When a TCP/IP connection request has been received, routine 300 at step 308 forks a new child process 312 to handle it. The routine 300 binds the newly forked child process 312 to a socket at 310, creating as many child processes 312.sub.1-N bound to each socket as there are data capture devices 30 that have requested connections to central message processor 50.

Detailed Description Text (61) :

Of course, switch capture devices 36 that reside on the central message processor 50 can store their captured data in a file on the central message processor 50. No process sockets routine need be initiated for these switch capture devices. Instead, the collation processing shown in FIG. 10 is done by accessing the resident file holding the captured data.

Detailed Description Text (65) :

Note that the processing associated with FIGS. 10A and 10B is directed to finding mates of invoke and return result messages and saving unmated messages until missing mates are captured and matched. This processing is necessary since the invoke and return result messages may not necessarily be captured and transmitted to the central message processor 50 immediately in the order in which they were generated. Thus, it is possible that a particular return result message is received well before its mating invoke message. Absent proper processing the return result message may be lost, eliminating valuable visibility or fraud data. For return result messages resident in the pairing buffer 410 for longer than a predetermined period, those "expired message," are identified by step 420 and then discarded. This is because the central message processor 50 generally receives return result message that may relate to invoke message that are not of a desired IS-41 message type. On the other hand, expired invoke messages identified at step 408 are flagged as unpaired and sent to the daily file database 160 for ultimate forwarding to a customer support station 60, 62 or 64 or fraud detection system 70. Expired invoke messages are saved because they may still provide the system information such as why the customer had a problem.

Detailed Description Text (69) :

To eliminate redundant data, the present invention provides a registration message processing and filter process 170 (implemented by central message processor 50) as described by the filtration process 500 shown by FIG. 11. A filters table 502 includes the identification of every MSC for which data is commercially received. Typically the identification is a System Identification Number or "SID" and, for smaller providers

- that simply contract another provider's network and provide billing services, a Billing Identification Number or "BID." Thus, for example, if data were already being sent to fraud detection system 70 for a switch in Nashville, Tenn., the filters table 502 would include that system's SID (or BID).

Detailed Description Text (75):

In any event, the database upon which all system fraud data resides is opened at step 614. The database is partitioned by day so that information retrieval is more efficient. Step 614 opens and prepares the database, while step 616 confirms that operation; if there is a failure an error message is displayed. Records are fetched from the database at step 618 and added to the main screen list box at step 626. The main screen list box allows the customer support application to store in RAM the results for the search parameters entered. This allows the particular customer on-line support stations 60, 62 or 64 to obtain its search results and load them locally for further processing, thereby providing distributed processing of search results to eliminate or minimize demands on the host database and its processor. If step 620 determines that a record fetch was unsuccessful, it may mean that the search results all have been retrieved. But if step 622 also determines that more data rows should be displayed, an error has occurred that step 624 displays. Otherwise, step 622 cycles back to the main screen display step 610 to await a new search by the operator.

Detailed Description Text (77):

This document has focused on describing several possible embodiments of the present invention, describing in particular detail alternative embodiments of data capture devices 30 coupled with a central message processor 50. Those skilled in the art will understand that of the alternative data capture devices 30 disclosed, the link capture device 32 is one of the most flexible because persons implementing the present invention need not rely on the assistance of third parties. For example, implementation of STP capture device 34 requires access to the telephone company's network; not all wireless providers will have such access, particularly where the network operator is a fierce competitor. Similarly, the switch capture device 36 requires obtaining expensive translation packages from switch manufacturers like AT&T and places the provider implementing the switch capture device 36 at the mercy of the switch manufacturer, who could always change protocols, overcharge for or eliminate altogether the translation packages.

Detailed Description Text (78):

Additionally, although the described embodiment discusses using a "central" message processor 50, the functionality of the central message processor 50 may be implemented by the data capture devices 30 simply by choosing platforms with sufficient processing power to perform the collating and filtering tasks of the central message processor 50. For example, link capture device 32 or STP capture device 34 each could be deployed on larger, more powerful workstations and couple via bus to a processor portion that processes selected message, pairing invoke and return result messages and saving unpaired invoke messages. Filters tables could even be downloaded to each data capture device 30 so that they can do necessary filtering of redundant fraud data.

Detailed Description Text (79):

Indeed, such a network design would decrease overall system bandwidth requirements and take advantage of the flexibility of distributed processing. That is, by having a central message processor 50 perform message collating and filtering, providers implementing the present invention must capture and send all return result messages as well as the invoke messages of interest to the central message process 50. This obviously consumes significant system bandwidth. Of course, it may allow for lower hardware costs since less powerful processing platforms need be deployed as data capture devices 30. In any event, those skilled in the art will recognize that the present invention contemplates various embodiments of data capture devices 30 and either distributed or central processing of captured messages so as to provide useful fraud, roamer visibility, customer support, network traffic management or other data useful in administering a wireless telecommunications system.

## WEST

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L26: Entry 34 of 51

File: USPT

Aug 8, 1995

DOCUMENT-IDENTIFIER: US 5440614 A

TITLE: System and method for dynamically specifying the manner in which calls to a roaming cellular telephone subscriber are to be handled

DATE FILED (1):  
19940825Abstract Text (1):

Disclosed is a system and method for enabling a cellular telephone subscriber located in a foreign service area to designate how calls placed to the subscriber should be handled by entering selections (such as call forwarding, caller notification) from the keyboard of his mobile telephone set. When these selections are received by a foreign service MTSO, the foreign service MTSO validates the roaming subscriber and the services that are available to the subscriber and then notifies the home MTSO how calls received at the home site should be handled. If the caller is to receive calls in the foreign service area (either forwarded calls or direct calls to the foreign service area), the foreign MTSO assigns a temporary roaming number to the subscriber for use in the foreign service area after the subscriber has been validated.

Brief Summary Text (4):

The forwarding of calls directly to the subscriber is not always appropriate, because in the present cellular telephone environment, the subscriber pays for the cost of the call. This means that a subscriber may be receiving calls that he does not want to receive and that he has to pay for. For this reason, subscribers frequently have calls sent to a voice mailbox or have the caller place the call directly to a foreign service area, in which case the caller would pay the long distance telephone charges. A subscriber using a cellular telephone in a foreign service area is generally referred to as a "roamer".

Brief Summary Text (5):

In order for a subscriber to instruct a caller to call a roaming subscriber, the subscriber would have to manually inform each potential caller of the roamer access number of the cellular telephone system that the roamer is using. Since the roamer could be moving from one roamer site to another, this is not always practical. Call delivery systems provided by some switch manufacturers (such as Motorola, AT & T and Ericsson) as well as the Follow Me Roaming product offered by GTE reduce this inconvenience to some extent but do not provide options of the present invention.

Brief Summary Text (7):

Another object of the present invention is to provide a cellular telephone system and method that automatically initiates call forwarding to a foreign service area after a subscriber places a first call in the foreign service area or enters a foreign service area with the cellular phone switched on.

Detailed Description Text (5):

A central host computer 14 after receiving the mobile identification number and selection code for the call routing option validates the subscriber to assure, among other things, that the subscriber's carrier in his home service area is part of the network companies supporting call forwarding. The appropriate commands are then sent by the central host computer 14 to the home MTSO to set up the call routing option that has been specified by the roamer. If the call routing option that was selected by the roamer is transparent call forwarding, the central host computer 14 obtains a temporary telephone number from the roam MTSO that would be associated with the MIN of

the roamer. This temporary telephone number must be assessable via the PSTN because it is the phone number to which the caller will be transferred. After the temporary telephone number is obtained from the roam MTSO, the central host computer 14 signals the home MTSO to complete activation. The central host computer 14 first determines that the roamer is currently call forwarded or no-answer transferred to other numbers, and if so, these numbers are saved and the existing feature is deactivated so that calls will no longer be directed to the numbers where they were previously directed. If the roamer does not have the no-answer feature, the feature is temporarily provided. The no-answer transfer telephone number that is entered is the temporary number that was obtained previously from the roam MTSO.

Detailed Description Text (6) :

Referring now to FIG. 3, when the central host computer 14 determines that it is time to deactivate a call routing of a roamer, it sends commands simultaneously to a home MTSO and the roam MTSO. At the home MTSO the roamer is restored to his original call routing status with the former call forwarding and no-answer transfer numbers restored. At the roam MTSO, the temporary phone number that has been obtained is freed so that it can be used for other roamers. Deactivation is initiated by either the roamer selecting a deactivation of the call forwarding from the mobile telephone by dialing \*310, or automatically after x number of hours (where x can be set dynamically by the carrier).

Detailed Description Text (9) :

If a roaming subscriber does not select a specific option when he is roaming, the system of the present invention will automatically activate a subscriber for automatic call forwarding when the roamer makes his first call in the roam site. In FIG. 5, the information flow for this activation of automatic call forwarding is shown. When the roamer makes his first call, the roam switch sends the MIN, roamer's electronic serial number (ESN) and the system ID (SID) of the roam switch to the central host computer 14. The central host computer 14 obtains the temporary phone number from the roam switch and sets up the roamer with call forwarding the temporary phone number to the home switch. The central host computer saves existing call handling settings.

Detailed Description Text (11) :

FIG. 7 shows the steps that occur when the VRS establishes the call handling setup and processes calls to the roamer. For the roamer to establish the desired call routing option desired, the roamer dials the selection from the pushbutton keypad of his mobile telephone handset in step 40. In step 42, the MTSO, in turn, routes the selection that the roamer made and the MIN of the roamer to the VRS 12. The VRS determines whether the call is from a roamer setting up his call handling or a call to a roamer, by counting in step 44 the number of digits that were sent. The roam switch ID code is six digits. The selection code plus the MIN of the roamer is always in excess of six digits. In step 44, the VRS 12 determines if the number of digits is greater than six, and if it is, in step 46 the roamer selection, MIN of the roamer and the roam switch ID code are sent to the central host computer 14. The VRS 12 keeps records of the total number of calls that were made and the selections that were made by the roamer, as shown in step 48. This information is available to the system user as a report. These reports can be obtained either automatically (at a predetermined time each day) or on the demand of the user. Monthly usage statistics reports are also provided. If the number of digits that was received was six, the VRS 12 searches a directory of switch codes. Corresponding to each switch code is a unique audio message which identifies the switch by location and roamer access telephone number and this message is fetched in step 50. The audio message that is associated with the particular roam site is then played to the caller in step 52. The VRS 12 keeps track of the total number of calls as well as the number of calls that are made to roamers at each roam site in step 54.

Detailed Description Text (20) :

The purpose of the NCDS.sub.-- DISPATCH module is to determine if the subscriber's request is valid, decide how to process the request, and then obtain the information that is needed to process the request. As illustrated in step 60, the central host computer 14 accesses the Roamer Agreement Database to determine if the service that is being requested by the Roamer is consistent with the agreement that exists between the home and roam carriers and the level of service that the roamer has selected. If the request is determined to be a valid request, the central host computer 14 accesses a

Positive Roamer Verification (PRV) Database to obtain the routing and switch information as shown in step 62. After this operation has been completed, the central host computer comes under the control of the NCDS.sub.-- CONTROL module.

Detailed Description Text (35):

If the roamer selects call forwarding, the central host computer issues a ALLOCATE.sub.-- TDN command to obtain a temporary telephone number from the roam switch. As shown in step 74, the Central host computer accesses the "roam" switch and obtains a temporary number for the roamer to use. The central host computer then issues an ENABLE.sub.-- TRANSFER command to set the subscriber's call forwarding to the temporary telephone number that was previously obtained from the roam switch. As shown in step 76, ENABLE.sub.-- TRANSFER causes the central host computer to access the "home" switch and change the roamer's call transfer number to the temporary number.

Detailed Description Text (36):

With reference to FIG. 9, the commands issued by the central host computer 14 to deactivate the call handling setup that had been established for a roamer to return the roamer to his original state will now be described. In step 82, the central host computer 14 operating under control of the NCDS.sub.-- CONTROL module determines if the roamer selection was for caller notification service or for transparent call forwarding service. If the roamer selection was caller notification, the DISABLE.sub.-- NOTIFICATION command is issued to access the home switch and return the subscriber's call forwarding features to their original settings as shown in step 84. If the roamer selection was transparent call forwarding, the DEALLOCATE.sub.-- TDN function is utilized in step 86 to return the temporary telephone number to the roam switch when the roamer is through using it. Then in step 88, the DISABLE.sub.-- TRANSFER function returns the subscriber's call forwarding settings to their original settings.

Detailed Description Text (38):

The NCDS.sub.-- VALIDATE command is issued to periodically revalidate any subscribers that are still active and have not been validated by NCDS in at least 24 hours by sending a FEATURES.sub.-- INQUIRY command to the home MTSO. If the subscriber is now invalid, a DEACTIVATE request is issued. Finally, as a safety system, the NCDS.sub.-- ALARM function periodically scans the list of all registered subscribers (regardless of their current call handling activation status) and reports any abnormalities.

Detailed Description Text (39):

In a preferred embodiment shown in FIG. 5a, the system also includes an autonomous registration system which enables an MTSO to detect the presence of a cellular phone in its home service area simply by virtue of the phone being switched on in the geographic area served by the MTSO or by virtue of a phone that it is on as the subscriber moves into the geographic area served by the foreign service area MTSO. In other words, the MTSO is capable of detecting the presence of a cellular phone subscriber in a service area even before the subscriber makes a call. This enables the subscriber to request that a system treat a registration event as an implicit selection of a call handling option. To do this, when a subscriber drives into a new foreign service area with the cellular phone powered-up, the cellular phone automatically detects a change in system ID and sends a registration message to the foreign service area MTSO identifying itself. This feature is built into almost all existing cellular phones. The foreign service area MTSO receives the registration message and notifies a central host computer that a subscriber has been registered. The central host computer checks to see if the caller has indicated that he wanted to activate a certain call handling option when he is in that particular foreign service area, and if that is the case, that service is then activated.

**CLAIMS:**

1. A method for enabling a cellular telephone subscriber to dynamically specify the manner in which calls to the subscriber are to be handled when the subscriber is located in a foreign service area, the method comprising:

detecting the presence of a subscriber in a foreign service area before subscriber makes a call by detecting a change in a MTSO system identification code;

sending a registration message to at roam site MTSO;

receiving at the roam site MTSO, information indicating which of at least two call handling options is being requested by the subscriber;

validating the subscriber requesting the call handling option;

providing information to a subscriber's home service area MTSO that indicates, based on one of said at least two call handling options, how calls to the subscriber are to be handled while the subscriber is located in the foreign service area; and

activating a call handling option for use within a particular foreign service area, if a subscriber had requested activation of said call handling option while in a previous service area.

4. The method for enabling a cellular telephone subscriber to dynamically specify the manner in which calls to the subscriber are to be handled of claim 1 wherein said step of receiving information indicating the type of call handling option comprises the steps of:

entering a code representing the selected call handling option directly into the cellular telephone;

sending a mobile identification number and said code from a foreign service area switch to a foreign service area voice response system.

5. The method for enabling a cellular telephone subscriber to dynamically specify the manner in which calls to a subscriber are to be handle to claim 1 wherein said step of validating the subscriber comprises the step of sending a mobile identification number, a system identification number of the foreign service area and a code representing the selected call handling option to a central host computer.

13. A system for enabling a cellular telephone subscriber to dynamically specify the manner in which calls to the subscriber are to be handled when the subscriber is located in a foreign service area, the system comprising:

means for detecting the presence of a subscriber in a foreign service area before the subscriber makes a call by detecting a change in an MTSO system identification code;

means for receiving one of at least two call handling instructions from a subscriber in a foreign service area for providing from the foreign service area a mobile identification number and a code representing the call handling instructions issued by the subscriber;

a central host processor means for validating the subscriber issuing call handling instructions and for providing information to the subscriber's home service area concerning which of said at least two call handling instructions are to be implemented while the subscriber is located in the foreign service area;

means for sending a registration message to the roam site MTSO; and

means for activating a call handling option for use within a particular foreign service area, if a subscriber had requested activation of said call handling option while in a previous service area.

19. A system for enabling a cellular telephone subscriber to dynamically specify the manner in which calls to the subscriber are to be handled when the subscriber is located in a foreign service area, the system comprising:

means for receiving at a roam site MTSO information indicating which of at least two call handling options is being requested by the subscriber;

means for validating the subscriber requesting the call handling option;

means for providing information to a subscriber's home service area MTSO that indicates, based on one of said at least two call handling options, how calls to the subscriber are to be handled while the subscriber is located in the foreign service area; and

means for activating a call handling option for use within a particular foreign service area, if a subscriber had requested activation of said call handling option while in a previous service area.

25. A method for enabling a cellular telephone subscriber to dynamically specify the manner in which calls to the subscriber are to be handled when the subscriber is located in a foreign service area, the method comprising:

sending a registration message to the roam site MTSO;

receiving at a roam site MTSO information indicating which of at least two call handling options is being requested by the subscriber;

validating the subscriber requesting the call handling option;

providing information to a subscriber's home service area MTSO that indicates, based on one of said at least two call handling options, how calls to the subscriber are to be handled while the subscriber is located in the foreign service area; and

activating a call handling option for use within a particular foreign service area, if a subscriber had requested activation of said call handling option while in a previous service area.

28. The method for enabling a cellular telephone subscriber to dynamically specify the manner in which calls to the subscriber are to be handled of claim 25 wherein said step of receiving information indicating the type of call handling option comprises the steps of:

entering a code representing the selected call handling option directly into the cellular telephone;

sending a mobile identification number and said code from a foreign service area switch to a foreign service area voice response system.

29. The method for enabling a cellular telephone subscriber to dynamically specify the manner in which calls to a subscriber are to be handled of claim 25 wherein said step of validating the subscriber comprises the step of sending a mobile identification number, a system identification number of the foreign service area and a code representing the selected call handling option to a central host computer.

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L26: Entry 30 of 51

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TITLE: Home location register for manual visitors in a telecommunication systemDATE FILED (1):

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Abstract Text (1):

A manual home location register (M-HLR) for use in a cellular telecommunication system provides manual visitors in a visited network with the same registration capabilities as automatic visitors from networks that have automatic roaming agreements with the visited network. The M-HLR maintains a database of manual visitor information separate from the network's database of home subscribers and automatic visitors. Initial registration in the visited network by a manual visitor is recorded in the M-HLR and enables the manual visitor to roam freely between multiple mobile switching centers (MSCs) in the visited network without having to re-register in each MSC.

Brief Summary Text (3):

This invention relates to cellular telephone networks, and more particularly, to foreign network registration of roaming cellular telephones.

Brief Summary Text (5):

In existing cellular telecommunication systems, when a subscriber leaves a home network and enters a visited network that does not have automatic roamer signaling with the subscriber's home network, that subscriber cannot originate calls until the subscriber is manually registered. With or without an operator's manual intervention, the roaming subscriber must be connected as a manual visitor with a validation against a clearinghouse or validation of a credit card. In addition, within the visited network, every time the subscriber roams from one mobile switching center (MSC) to another visited MSC, the subscriber must go through the same procedure to re-register as a manual roamer.

Brief Summary Text (6):

In some networks, the manual registration procedure must be repeated every time the subscriber originates a call. Additionally, in order to minimize fraudulent calls, no call delivery is provided to manual subscribers because subscriber records are kept only for the duration of each call.

Brief Summary Text (8):

In a cellular telecommunication system in which mobile subscribers may roam from a home network to a visited network having an automatic roaming agreement with the home network, and to a visited network without an automatic roaming agreement with the home network, the present invention provides visiting subscribers to a visited network without an automatic roaming agreement with the subscriber's home network with the same registration capabilities as visiting subscribers to a visited network having an automatic roaming agreement with the home network.

Brief Summary Text (9):

The system of the present invention includes means within each visited network for identifying the home network of each visiting subscriber and means within each visited network for determining whether or not the home network of each visiting subscriber has an automatic roaming agreement with the visited network. The system also includes means within each visited network for classifying as an automatic visitor each visiting subscriber whose home network has an automatic roaming agreement with the

visited network, and means within each visited network for classifying as a manual visitor each visiting subscriber whose home network does not have an automatic roaming agreement with the visited network. Further, the system includes means within each visited network for maintaining a database of information on manual visitors, and means for storing in the database, registration information regarding each manual visitor. The storing means stores the registration information upon each manual visitor's initial call attempt in the visited network. Finally, the system includes means for accessing from each of the visited network's mobile switching centers, the database of registration information upon each call to be delivered to the manual visitor or each manual visitor's subsequent call attempts within the visited network.

Drawing Description Text (4):

FIG. 2 (Prior Art) is an illustrative representation of three cellular radio communications networks of the type illustrated in FIG. 1, with a first network being a subscriber's home network, a second network being a visited network having an automatic roaming agreement with the home network, and a third network being a visited network that does not have an automatic roaming agreement with the home network;

Drawing Description Text (5):

FIG. 3 is a signaling diagram illustrating the flow of messages between an old serving MSC, a HLR, and a new serving MSC during the registration and validation process as a mobile subscriber roams from the old serving MSC to the new serving MSC;

Drawing Description Text (6):

FIG. 4 is an illustrative representation of a visited cellular radio communications network that does not have an automatic roaming agreement with the home network and has been implemented with a manual home location register of the present invention; and

Detailed Description Text (4):

With continuing reference to FIG. 1, a plurality of mobile stations M1-M10 may be found within the cells C1-C10. Again, only 10 mobile stations are shown in FIG. 1 but it should be understood that the actual number of mobile stations will be much larger in practice and will invariably greatly exceed the number of base stations. Moreover, while none of the mobile stations M1-M10 may be found in some of the cells C1-C10, the presence or absence of the mobile stations M1-M10 in any particular one of the cells C1-C10 should be understood to depend, in practice on the individual desires of the subscribers associated with mobile stations M1-M10 who may roam from one location in the cell to another or from one cell to an adjacent cell or neighboring cell, and even from one cellular radio exchange served by a mobile switching center to another such exchange.

Detailed Description Text (6):

Within the geographic coverage area served by a specific cellular communication network, there may be one MSC, or there may be several MSCs which are interconnected and connected to the PSTN or ISDN. The network may also include a home location register (HLR) which maintains a database of subscriber information. The relevant connections between the MSCs, and between the MSCs and the HLR, PSTN, or ISDN, are not completely shown in FIG. 1 but are well known to those of ordinary skill in the art.

Detailed Description Text (7):

There are generally two types of mobile subscribers, automatic subscribers and manual subscribers. An automatic subscriber is one for which the network in which the subscriber is located automatically updates the location and registration of the subscriber as the subscriber moves from one MSC to another within the network. This automatic location and registration eliminates the requirement for the subscriber to register with the network whenever the subscriber moves from one MSC to another within the network. Subscribers within their home network are automatic subscribers.

Additionally, operators of different networks having signaling links between them may enter into automatic roaming agreements that provide their respective subscribers with automatic subscriber status when operating within each other's networks, thereby providing subscribers with the capability to roam between each other's networks without loss of services.

Detailed Description Text (8):

Each network may include a home location register (HLR) which stores subscriber information in a database and enables automatic updating of location and registration information for home subscribers and automatic visitors from other networks having automatic roaming agreements with the home network. When a subscriber enters a visited network that has an agreement with the subscriber's home network, and turns on his phone, the interface between the phone and the network recognizes the subscriber as being from a network having an automatic roaming agreement. The visited network makes a record of the subscriber in the MSC where the visiting subscriber is located and notifies the home network to update the location of the subscriber in the home network's database (HLR). Thereafter, calls directed to the subscriber in the home network are automatically forwarded to the visited network.

Detailed Description Text (9):

FIG. 2 is an illustrative representation of three cellular radio communications networks with a first network 11 being a subscriber's home network, a second network 12 being a visited network having an automatic roaming agreement with the home network, and a third network 13 being a visited network that does not have an automatic roaming agreement with the home network. While the networks of FIG. 2 are illustratively shown to each include three MSCs interconnected by signaling links 14, it should be clearly understood that in practice, the number of MSCs may vary and still fall within the scope and spirit of the present invention.

Detailed Description Text (10):

The home network 11 provides automatic subscriber status to all mobile subscribers subscribing to its service. Thus, a home subscriber may roam freely from MSC1 to MSC2 and MSC3 within the home network 11 without having to re-register with the home network. A signaling link 15 between the home network 11 and the visited network 12 indicates that there is an automatic roaming agreement between the home network 11 and the visited network 12 for the visited network to treat visiting subscribers from the home network as automatic subscribers. Thus, roaming subscribers from the home network 11 may roam freely between MSCs 1, 2, and 3 in the visited network 12 having the agreement.

Detailed Description Text (11):

A metropolitan network is any group of automatic roaming cooperating MSCs sharing the cellular coverage of a certain geographic area, typically a city. A function identified as Local Access to Automatic Visitors allows incoming calls through a roamer port to be delivered to automatic visitors within the roamer port area in the metropolitan network.

Detailed Description Text (12):

Upon reception of an incoming call through a local access roamer port, a second dial tone is generated toward the calling subscriber. The calling subscriber then dials the called mobile subscriber's 10-digit directory number (including area code), and if the call is intended for an automatic visitor, the home system is interrogated to provide the roaming routing number corresponding to the subscriber's location. If the received roaming routing number belongs to the corresponding roamer area in the metropolitan network, the call is routed to the appropriate MSC within the metropolitan network. Otherwise, the call is rerouted according to the exchange data, e.g. the calling party is informed that the mobile subscriber cannot be reached.

Detailed Description Text (13):

A manual subscriber is one for which the network in which the subscriber is operating does not automatically update the location and registration of the subscriber as the subscriber roams from one MSC to another within the network. Such a situation arises when, as illustrated in FIG. 2, a subscriber from the home network 11 travels to the visited network 13 which does not have an automatic roaming agreement with the home network to provide automatic subscriber service. Manual subscribers must re-register with the visited network 13 whenever they roam from one MSC to another within the visited network. In addition, to help prevent fraud, many visited networks require such manual visitors to re-register before making each call, even if they have not roamed from a MSC in which they previously registered. Such per-call registration may be handled by a human operator or a mechanical operator with, for example, recorded voice instructions. Registration may include validation of credit card numbers or other means of making payment for cellular telephone services by accessing a database

of bad credit card numbers.

Detailed Description Text (17) :

FIG. 3 is a signaling diagram illustrating the flow of messages between an old serving MSC 21, a HLR 22, and a new serving MSC 23 during the registration and validation process as a mobile subscriber roams from the old serving MSC 21 to the new serving MSC 23. After determining at step 41 that a roaming mobile is now within its service area, the new serving MSC 23 sends a REGNOT (Registration Notification) INVOKE message 24 to the new serving VLR 25. The new serving MSC 23 may detect the mobile subscriber's presence through autonomous registration, call origination, or service order.

Detailed Description Text (20) :

If the mobile subscriber was previously registered in an old serving VLR 29 and MSC 21, the HLR 22 sends at step 43 a REGCANC (Registration Cancellation) INVOKE message 31 to the old serving VLR 29. The old serving VLR 29, upon receipt of the cancellation message 31, removes all record of the mobile subscriber from its memory, and a REGCANC response message 32 is returned to the HLR 22. The REGCANC INVOKE message 31 may be sent by the HLR 22 at any time after it receives the REGNOT INVOKE message 26.

Detailed Description Text (22) :

At step 45, the new serving VLR 25 creates an entry for the mobile in its internal data structures and may send a QUALREQ (Qualification Request) INVOKE message 35 to the HLR 22 in order to authenticate the mobile subscriber and determine validation requirements as indicated in a QUALREQ response message 36. If required, the new serving VLR 25 may then send a PROFREQ (Service Profile Request) INVOKE message 37 to the HLR 22 at step 46 in order to obtain the service profile for the roaming mobile subscriber, as indicated in a PROFREQ response message 38.

Detailed Description Text (24) :

Delivery of calls to manual roamers also poses a problem in existing telecommunications networks. If a subscriber roams from the home network to the visited network without agreement, the subscriber must register with the visited network before he can initiate or receive telephone calls. Otherwise, the subscriber will get a "no service" message on his mobile station. Once the subscriber has registered with the visited network, the operator of the visited network informs the home network that the subscriber is now located in the visited network and provides an access telephone number for the visited network. The access number is often referred to as a pilot number or, preferably, a roamer port number (RPN).

Detailed Description Text (25) :

Subsequently, if someone calls the subscriber at the subscriber's telephone number in his home network, the calling party will hear a message that the subscriber is now in the visited network, and providing the RPN. If the calling party dials the RPN, he obtains a dial tone for the visited network. The calling party then dials the subscriber's regular 10-digit directory number (including the 3-digit area code) in order to complete the call.

Detailed Description Text (26) :

An additional problem arises most often in metropolitan areas when the visited network without agreement comprises more than one MSC. There can be only one RPN for the visited network because the RPN is connected through the Public Switched Telephone Network (PSTN) to the home network. The visited network is then a single roamer port area which includes multiple MSCs. Thus, the RPN provides a port into the visited network, but does not identify to the home network a particular MSC within the visited network in which the subscriber may be found.

Detailed Description Text (28) :

FIG. 4 is an illustrative representation of a visited cellular radio communications network 51 that does not have an automatic roaming agreement with the home network and has been implemented with a manual home location register (M-HLR) 52 of the present invention. The present invention solves many of the problems associated with registration of manual visitors and call delivery to manual visitors by providing a means for treating manual visitors as automatic visitors. The M-HLR 52 includes a database for manual visitors, and is implemented within the network 51 and connected

to MSC1, MSC2, and MSC3. The M-HLR 52 may be a standalone node, may be co-located with any MSC in the network, or may be co-located with a HLR, if applicable. If implemented as a standalone node, the M-HLR 52 has its own standalone processor to perform database and control functions. If co-located with a MSC or HLR, the M-HLR 52 may share a processor while accessing its manual visitor database.

Detailed Description Text (30) :

The first time a manual visitor makes a call in the visited network from, for example, MSC1, the registration/validation procedures are unchanged from the existing procedures as illustrated in FIG. 3. However, the registration is recorded in the M-HLR 52, instead of MSC1 in which the manual visitor is located. The manual visitor can then move freely around the visited network 51 without having to re-register in each MSC. Cancellations of subscriber records in the M-HLR 52 are based on activity supervision, as is currently performed in existing systems. Maintenance of manual visitor records in the M-HLR 52 has the additional benefit of increasing the subscriber capacity of the MSC's in the visited network 51. All of the MSC's available records may be reserved for automatic visitors since there is no need to reserve any records for manual visitors.

Detailed Description Text (33) :

At step 81, a call to be routed to a roamer port access is received from the public switched telephone number (PSTN), and a second dial tone is generated toward the calling subscriber. The calling subscriber then dials the called subscriber's 10-digit directory number. At step 82, the originating MSC 61 sends a LOCREQ (Location Request) INVOKE message 66 to the HLR 62 associated with the mobile station. This association is made through the dialed mobile address digits.

Detailed Description Text (34) :

At step 83, if the dialed mobile address digits are assigned to a legitimate subscriber, and if call forward unconditional is not in effect (as defined by the service profile) the HLR 62 sends a ROUTREQ (Routing Request) INVOKE message 67 to the VLR 68 that last provided a registration notification. This serving VLR 68 then forwards a ROUTREQ INVOKE message 69 to the current serving MSC 63. The mobile station may have roamed within the network served by the serving VLR 68 and reported its new location to the serving VLR 68 via the serving MSC 63. The serving VLR 68 may not have reported this change in location to the HLR 62.

Detailed Description Text (36) :

At step 85, if the mobile station is located in the roamer port area, then the serving exchange MSC 63 allocates a temporary local directory number (TLDN) and returns this information to the HLR 62 in a ROUTREQ response message 73. Otherwise, if the mobile station was located outside the roamer port area, then the call is terminated according to the exchange data. When the ROUTREQ response message 73 is received by the HLR 62, the HLR constructs a LOCREQ response message 74 by adding the mobile identification number (MIN) and electronic serial number (ESN) of the mobile to the information provided by the serving MSC 63. The HLR 62 then returns the LOCREQ response message 74 to the originating MSC 61. At call setup at step 86, the originating MSC 61 establishes a voice path to the serving MSC 63 using existing interconnection protocols and the TLDN specified in the LOCREQ response message 74.

Other Reference Publication (2) :

Hans Lindqvist, The Future of Roaming Services and Cellular Networking, 1987, pp. 923-926.

CLAIMS :

1. In a cellular telecommunication system in which mobile subscribers may roam from a home network to a visited network having an automatic roaming agreement with said home network, and to a visited network without an automatic roaming agreement with said home network, a system for providing visiting subscribers to said visited network without said automatic roaming agreement with the same registration capabilities as visiting subscribers to said visited network having an automatic roaming agreement with said home network, said system comprising:

means within each visited network for identifying the home network of each visiting

subscriber;

means within each visited network for determining whether or not the home network of each visiting subscriber has an automatic roaming agreement with the visited network;

means within each visited network for classifying as an automatic visitor each visiting subscriber whose home network has an automatic roaming agreement with the visited network;

means within each visited network for classifying as a manual visitor each visiting subscriber whose home network does not have an automatic roaming agreement with the visited network;

means within each visited network for maintaining a database of information on manual visitors;

means for storing in said database, registration information regarding each manual visitor, said storing means storing said registration information upon each manual visitor's initial call attempt in said visited network; and

means for accessing from each of said visited network's mobile switching centers, said database of registration information upon each manual visitor's subsequent call attempts within said visited network.

2. The system of claim 1 wherein said means within each visited network for identifying the home network of each visiting subscriber includes means for identifying the home network by reading each subscriber's mobile identification number.

4. The system of claim 3 wherein said manual home location register is a standalone node.

5. The system of claim 3 wherein said manual home location register is co-located with a mobile switching center.

6. The system of claim 3 wherein said manual home location register is co-located with a home location register.

7. In a cellular telecommunication system in which mobile subscribers may roam from a home network to a visited network having an automatic roaming agreement with said home network, and to a visited network without an automatic roaming agreement with said home network, a method of providing visiting subscribers to said visited network without said automatic roaming agreement with the same registration capabilities as visiting subscribers to said visited network having an automatic roaming agreement with said home network, said method comprising the steps of:

identifying the home network of each visiting subscriber within each visited network;

determining whether or not the home network of each visiting subscriber has an automatic roaming agreement with the visited network;

classifying as an automatic visitor each visiting subscriber whose home network is determined to have an automatic roaming agreement with the visited network;

classifying as a manual visitor each visiting subscriber whose home network is determined not to have an automatic roaming agreement with the visited network;

maintaining, within each visited network, a database of information on manual visitors;

storing, in said database, registration information regarding each manual visitor upon each manual visitor's initial call attempt in said visited network; and

accessing, from each of said visited network's mobile switching centers, said database of registration information upon each call to be delivered to the manual visitor and

upon each manual visitor's subsequent call attempts within said visited network.

8. The method of claim 7 wherein said step of identifying the home network of each visiting subscriber within each visited network includes identifying the home network by reading each subscriber's mobile identification number.

**WEST** [Generate Collection](#) [Print](#)

L17: Entry 13 of 263

File: USPT

Aug 10, 1999

DOCUMENT-IDENTIFIER: US 5937343 A

TITLE: Method and system for updating replicated databases in a telecommunication network system

DATE FILED (1):19940913Abstract Text (1):

A method and system of the present invention updates a replicated database of a telecommunications network system. A call transport system forwards calls from a local telephone station to a destination. A signaling system is operatively connected to the call transport system and includes primary site databases containing customer records for call routing and other signaling functions and at least one secondary site database containing the customer records of the primary site database. Both primary and secondary site databases maintain multiple versions of the same customer record so that queries of a call can use a version number to access the corresponding version of the record in the same database for consistent routing and other signaling information. A customer record is updated in the primary site database and that information is transmitted through the signaling network to the secondary site database containing the replicated version of the record. The records are then updated according to the sequence of the version number. The processing of all calls querying the previous version of the primary and secondary site database record is completed before the previous version of the database record is deleted.

Brief Summary Text (6):

A proposed method to support terminal mobility requires a home database (or Home Location Register, HLR) and a visitor database (or Visitor Location Register, VLR). In a proposed design, the home database is accessed by a fixed, wired network while the visitor database is connected to a switch in the wireless network. The routing and other signaling functions of each call initiated from or destined for mobile customers requires a use of the information stored in the databases.

Brief Summary Text (11):

In telecommunications, however, inconsistency between replicated copies of customer records for a brief period of time can be tolerated because the major consequence of accessing obsolete information will be a "call misroute". The network can allow a small fraction of calls misrouted as long as the number of misrouted calls is very small compared to the overall call volume.

Brief Summary Text (14):

In accordance with the present invention, a method and system for updating replicated databases in a telecommunications network system to improve call setup time and system availability is disclosed, and otherwise known as a primary writer protocol. The system includes a call transport system having switches for forwarding calls from a local station through the call transport system to a destination. A signaling system is operatively connected to the call transport system, and includes a primary site database containing customer records for call routing and other signaling functions, and at least one secondary site database containing the replicated customer records of the primary site database.

Brief Summary Text (15):

In one aspect of the invention, a field is added to each customer record corresponding to a version number of the record so as to identify the record referenced by queries

of calls in progress. The records are updated in the secondary site database by using the version number sequence of the updated database records. Another field is added to the record corresponding to a call counter to indicate the number of ongoing calls that previously accessed that version of the record. The call counter field is incremented if a new call setup references to it and decremented when the call setup is completed. The previous (i.e., obsolete) database record is deleted when the call counter is zero.

Brief Summary Text (17):

If the customer record is updated in the primary site database successfully, information concerning the updated database record is transmitted through the signaling network to the secondary site database containing the previous replicated version of the record. Updates at the secondary site database are processed in the sequence of the version number. The processing of all calls querying both the primary and secondary site databases are completed before the previous version of the database record is deleted. These multiple versions of records are maintained in the primary and secondary databases so that queries for a call can access the same version of the associated record for consistent routing and other signaling information.

Detailed Description Text (3):

In accordance with the present invention, a customer record is updated in a primary site database within the signaling system of a telecommunication network, which includes a call transport system with switches for forwarding calls from a local telephone station through the call transport system to a destination. The information concerning the updated database record is transmitted through the signaling network to at least one secondary site database which contains the previous replicated version of the primary site database record. The customer record is changed at the secondary site to reflect changes in the database at the primary site. The older versions of the record are maintained at both primary and secondary site databases for query access until after completing the processing of all previous calls querying the versions of the record at the database site.

Detailed Description Text (6):

FIG. 1 illustrates an intelligent network, shown generally at 10, having a transport network, indicated generally at 12, and signaling network such as the common SS7 network 14. The transport network 12 includes a wired network 20, and could include a wireless network 16 for mobile units 22. The transport network 12 connects to the local central office 23 and the local telephone station 24.

Detailed Description Text (9):

Since the distributed database issues are common to the PCN, the UPT services, and possibly other services involved in the use of databases (e.g., Network Control Points, NCPs) in the IN, the general terminology for distributed database systems is adopted in the following specification. The computer system 30, 30a for respective primary and secondary sites where parts of the database are located is referred to hereafter as sites. Customer records for call routing, features, service profiles, and other signaling information are called records. Reads and writes to the database are also referred to as queries and updates, respectively. To enable recovery from system failures (except disk crashes), each site keeps a log (also known as journal) of all updates made to the local database in a stable memory 36, 36a which can survive the failures.

Detailed Description Text (10):

In accordance with the present invention used with telecommunication services, the database 26a consists of a collection of individual records, which are distributed and replicated at multiple sites, such as the secondary site database 28a. Queries associated with a call, and updates for a customer, access a particular record in the database. Thus, the readset and writeset of a query and an update are one record. As a result, if queries and updates are processed atomically, unnecessary data inconsistency can be avoided.

Detailed Description Text (11):

Furthermore, several queries may be launched to access the associated record during the call setup time, which typically lasts several seconds. Although the record may have been updated in the meantime, it is advantageous not to immediately remove an

obsolete copy of the record so that subsequent queries of the calls in progress can be processed in a consistent way according to the previous record. This eliminates the need for locking records for query processing without being concerned about data inconsistency. Additionally, calls will not be mishandled while the customer's record is updated. This would be more difficult if the readset and writeset of queries and updates consisted of many records and files, as in the database systems of other applications.

Detailed Description Text (13):

Since the readset (or writeset) of each query (or update) is one record, the concurrency control protocol must only maintain the internal and mutual consistency at the record level. With internal consistency, data items in each record at every site are always consistent. For example, the routing data in a record must be valid so that calls can be routed properly. Mutual consistency is preserved, if copies of a record replicated at different sites become identical in a finite amount of time after a number of updates have been posted to the record. The commitment protocol is designed to enable the system to recover from system failures, i.e., those updates that have been committed will not be undone. As illustrated below, the present invention provides a single protocol which performs the concurrency control and the commitment functions.

Detailed Description Text (16):

b. Records of the database 26a are distributed and replicated at the sites. For example, a record (record A) is replicated at N sites, indexed by  $i=1, 2, \dots, N$ . To take advantage of load balancing, the initial queries of calls requiring access to record A are sent to those N sites according to some call distribution algorithm known to those skilled in the art, such as the generalized round-robin algorithm, or a static scheme. To avoid unnecessary data inconsistency if a call setup involves multiple queries to the same record, subsequent queries of a call are routed to the same site where the initial query of the call is processed.

Detailed Description Text (17):

c. Each site 26, 28 can keep multiple versions of a record so that queries for a call can access the same version of the associated record for consistent routing and other signaling information. An obsolete version of the record is deleted after the process of all calls querying it has been completed.

Detailed Description Text (21):

To ensure the correct operations of the protocol, two fields are added to each record: 1) a version number (VN) and 2) a call counter (CC). The version number is used to identify the version of a record referenced by queries of calls in progress, while the call counter indicates the number of ongoing calls, that have previously accessed that version of the record. If the call counter is zero, and the record has been updated, the older version of the record is deleted. At any given time, there are probably very few (e.g., two) versions of the same record existing at a site because all setup time lasts only a few seconds and inter-update time is typically much longer than that.

Detailed Description Text (22):

For purposes of understanding the details of the present invention, the following notations apply. R.sub.A (n) is the version of record A with the version number (VN) being n for  $n=0, 1, 2, \dots$ , and call counter, CC(n) denoting the cc of R.sub.A (n). Assume that R.sub.A (0) initially exists in the system. Further, let v.sub.-- late be the VN of the latest version of record A existing at a site. U.sub.n denotes an update to record A, which successfully creates R.sub.A (n). The primary-write protocol of the present invention can be further described as follows. If the query for record A is the first query of a call, then

Detailed Description Text (44):

The system allows non-identical copies of records replicated at different sites to be available for call processing simultaneously. Thus, queries may access the obsolete information at some secondary sites while updates are pending for processing, thus causing call misroutes. As discussed before, if the probability of such occurrence is satisfactorily small, exclusive access to the records during updates is not needed. Without exclusive access, the system is deadlock free.

Detailed Description Text (51) :

A fraction of calls may be misrouted by the method of the present invention because of accessing obsolete information at some secondary site databases, while updates are pending. The fraction of calls misrouted is a key performance measure for determining whether or not the method of the present invention is applicable to a particular application.

Detailed Description Text (54) :

Based on a performance study with typical parameters in today's telecommunication networks, results in FIGS. 5-7 show that the fraction of calls misrouted under the method of this invention is satisfactorily small (e.g., less than 10.<sup>sup.-4</sup>) for a wide range of expected customer behavior (in term of call throughput and ratio of record read-write frequencies R.sub.q) in the Personal Communication Networks (PCN), wireless networks, Universal Personal Telecommunication (UPT) services and other advanced services to be offered by the Intelligent Networks (IN).

Detailed Description Text (57) :

As shown in block 100, the customer record at the primary site is first updated. The update is then checked for any data inconsistency in block 102. If there is an inconsistency, the update program is terminated in block 104. If there is no data inconsistency, the update is then processed in block 106 and a new version of the record is created in block 108. The update is committed in the log in block 110. The information relating to the update is then transmitted to databases at secondary sites in block 112. The secondary site updates by using the version number in block 114. Secondary site then creates a new version of the record in block 116. The update is committed in the log at the secondary site in block 118. If the call counter of the last version of the record is zero in block 120, then the old database record is deleted in block 122. Regardless whether the call counter is zero or not, the secondary site sends an acknowledgement to the primary site as the update has been successfully processed in block 124. The process continues with the next update in block 126.

Detailed Description Text (61) :

The current approach to supporting the terminal mobility requires a home database (or Home Location Registers, HLR) and a visitor database (or Visitor Location Registers, VLR). This HLR-VLR architecture actually has been established as an industry standard in the Global System for Mobile Telecommunications (GSM) for Europe and the IS-41 recommendations for North America. The home database can be accessed by the fixed, wired or wireless network, whereas the visitor database is connected to a switch (referred to as the mobile switching center, MSC) in the wireless network. The routing and other signaling functions of each call initiated from or destined for a mobile customer requires the use of the location information stored in the databases. The protocol and the associated architecture for supporting the terminal mobility are well defined, and understood by those skilled in the art.

Detailed Description Text (66) :

1. Customers traveling abroad have to register from the visited country so that the network is informed of their current locations (e.g., in terms of POTS numbers in wired networks, or mobile station roaming numbers in wireless networks). This location information for all customers subscribing to the UPT services is stored in the centralized database, which can be supported by a Network Control Point, NCP. Signal transfer points 204 in the U.S. network communicate with signal transfer points 206 in country 1, and any other country in 210. Country 1 includes a VLR 212 connected to a MSC 214 in the wireless network 216. Country 1 also includes a wired network 218. Country n also includes similar elements referenced by prime notation.

Detailed Description Text (70) :

3. When a call is destined for a UPT customer located either in the U.S. or abroad, the signaling network queries the centralized database 200 for the location information for call setup and other signaling functions.

Detailed Description Text (92) :

A mobile, wireless customer is roaming in a foreign country. As a customer moves from one location area to another, the customer location information in the visitor database is updated frequently. The corresponding customer record in the home database

is also updated. Thus, the transmission and processing costs for maintaining the current location information in the home database will be significant, especially if the customer is located far away from the U.S. The situation will become even worse if the customer moves from location to location without making or receiving calls; i.e., no revenue is received to cover the cost incurred in handling the database updates.

Detailed Description Text (94):

As a result, the home database does not need to update the location information every time a customers changes its location overseas. Furthermore, calls originated from the U.S., destined for a customer traveling overseas first retrieves the identifier from the home database and then accesses the current location information in the visitor database for call setup and other signaling functions.

Detailed Description Text (103):

As a result, for calls originated in a foreign country and destined for a network roaming customer, only networks of the company in question are equipped to carry the calls. Such an arrangement can also be used to enhance the U.S. network's position in partnering with service providers overseas. In another business arrangement, the telephone network may also choose to furnish, for a fee, some foreign carriers with certain signaling information to carry calls destined for the network customers traveling in the country. Furthermore, if the telephone network can work with its business partners abroad, the replicated database design can be implemented in an alternative way.

Detailed Description Paragraph Table (1):

begin Access R.sub.A (vn.sub.-- late); (\*Access to the latest version of record A at the site\*) Record the VN, vn.sub.-- late, for the call; CC(vn.sub.-- late) .rarw. CC(vn.sub.-- late) + 1 end

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CLAIMS:

1. A method for updating a replicated database in a telephone network system to improve call setup time and system availability comprising the steps of  
updating a customer database record contained in a primary database at a primary site within a signaling system of a telephone network, wherein the telephone network includes a call transport system with switches for forwarding calls from a local telephone station through the call transport system to a destination,  
transmitting information concerning an updated database record in the primary database through the signaling system to at least one secondary database at a secondary site which contains a replicated version of the database record in the primary database,  
adding a field to the updated database record corresponding to a version number sequence of the database record so as to identify versions of the database records referred by queries of calls in progress,  
changing the database record in the secondary database to reflect changes in the primary database by using the version number sequence of updated database records, while maintaining at all database sites an older version of the database record that has been updated for query access until after completing the processing of all previous calls querying the older version of the database record, and  
retransmitting information concerning the updated database record to the secondary database if the primary site does not receive an acknowledgement of processing completion from the secondary site prior to the expiration of a time-out period.
8. The method according to claim 1 including deleting a previous version of the database record at all sites after completing the processing of all calls querying the previous version of the database record.
9. The method according to claim 1 including maintaining multiple versions of database records at the primary and secondary sites so that queries for a call can access the same version of the associated record in the same database for consistent routing and

, signaling information.

10. The method according to claim 1 including adding a call counter field to the database record to indicate the number of ongoing calls whose queries have previously accessed that version of the database record.

12. The method according to claim 11 including deleting the previous version of the database record when the value in the call counter field is zero.

15. A system for updating replicated databases in a telephone network system to improve call setup time and system availability comprising

a call transport system having switches for forwarding calls from a local telephone station through the call transport system to a destination,

a signaling system operatively connected to the call transport system, and including a primary database at a primary site within the signaling system containing customer database records for call routing and other signaling functions and at least one secondary database at a secondary site containing at least some of the customer database records of the primary database,

means for updating a customer database record in the primary database,

means for transmitting information concerning the updated customer database record through the signaling system to the secondary database containing a previous version of the database record that had been updated in the primary database,

means responsive to the completion of all calls querying the previous version of both primary and secondary database records for deleting the previous version of the database record, and

means for updating the database records in the secondary database by a version number sequence of the updated database records.

18. The system according to claim 15 including means for maintaining multiple versions of customer database records in the primary and secondary databases so that queries for a call can access the same version of the associated record in the same database for consistent routing and signaling information.

19. The system according to claim 15 wherein each updated database record includes an identifying field corresponding to a version number of the database record so as to identify the database record referenced by queries of calls in progress.

20. The system according to claim 15 wherein each database record includes a call counter field for indicating the number of ongoing calls whose queries have previously accessed that version of the database record.

22. The system according to claim 21 including means for deleting the previous version of the database record when the value in the call counter field is zero.

**WEST** [Generate Collection](#) [Print](#)

L11: Entry 41 of 110

File: USPT

Jan 6, 1998

DOCUMENT-IDENTIFIER: US 5706330 A

TITLE: Method and apparatus for tracking and transmitting communication information for wireless communication systems

DATE FILED (1):  
19950214Brief Summary Text (6):

Moreover, current data retrieval systems unnecessarily tie up costly air time during transmission of call data report information from a remote location to a central billing location.

Brief Summary Text (7):

When a rental car is equipped with a cellular telephone, cellular telephone usage may need to be determined in order for the rental agency to accurately bill the rental customer for the usage of the cellular telephone. It is inconvenient and economically impractical for the rental agency to wait for the end of the month to receive the cellular telephone usage report from the cellular telephone company, and then from that report to charge the rental customer for the usage of the cellular telephone. Cellular telephone usage must be calculated quickly and accurately so that the rental agency can correctly charge the rental customer for the usage of the cellular telephone. If a cellular telephone by itself is rented, then usage of the cellular telephone may also need to be monitored so that proper rental rates can be calculated by the rental agency.

Brief Summary Text (8):

Since a cellular telephone has airtime charges which are incurred whenever the telephone is used, both for outbound and incoming calls, the usage of the cellular telephone for both incoming and outbound calls must be monitored. A system to monitor cellular telephone usage must record the date and time of the start of any telephone call, either incoming to the cellular telephone or outbound from the cellular telephone, the duration of the telephone call, an indication that a particular call was incoming or outbound, any digits which were dialed to place an outbound cellular telephone call, and any special billing factors that were created; such as roaming charges. This information is needed in order to accurately monitor cellular telephone usage. In the case of a telephone which is rented and for which a billing must be created based upon usage of the cellular telephone, the bill for the rental customer can be calculated based upon this information. This information must also be known if a printout or computer record which provides a record of the cellular telephone usage is to be created.

Detailed Description Text (12):

Roaming call-in when the phone detects a roaming state and calls in to the collector system 302; and

Detailed Description Text (35):

With this invention, the phone performs self-diagnostics whenever not in use by the customer. Whenever the phone determines that it is not capable of performing its duties, or when marginal errors are detected, the phone calls in to the collector system and reports its condition.

Detailed Description Text (38):

Incoming calls are calls destined for the cellular phone. There are two categories of

incoming calls: (1) billed and (2) maintenance. Billed calls are completed only after the phone has been unlocked by an accepted credited card swipe with time remaining after the pre-authorization. Detailed information must be kept on a per-call basis, and includes: calling number, called number, start time, end time, call duration, roaming or SID area. This data is required in order to bill the airtime to the customer's credit card. Maintenance calls are designed to remotely harvest CDR records, to update cellular software, and/or obtain information about the cellular set, for example, if the phone has been inoperative for a predetermined period of time, e.g. 24 hours.

Detailed Description Text (48):

Because the present invention transfers data during non-billable airtime or when the airtime is billed at a reduced rate, the system of the invention better utilizes the deployed equipment, minimizes internal airtime charges, and provides an efficient method with which to bill customers.

Detailed Description Text (51):

The bill tracking and transmitting system of the invention reduces communication charges, and reduces billing errors. By transferring previously stored CDR information during the subsequent pre-authorization request, at least one communication charge is eliminated. Moreover, the mobile phone unit is cleared of previous call data. The invention therefore further reduces the possibility of billing errors by providing for discrete data reports for each customer, or for each authorization request of the same customer.

Detailed Description Text (54):

The present invention is also programmed to provide efficient roaming status management. The purpose of roaming status management is to reduce communication costs when a phone unit is out of its home system area. In the event that a mobile communication unit is out of its home system, and roaming for more than a predetermined amount of time, the phone unit or C3PO will then call in to the collector system to acquire a reassigned NAM. The reassigned NAM will be assigned from a reserved pool of numbers and will be linked to that mobile unit's ESN. The new NAM will then be down-loaded to the mobile unit and immediately activated at the new home carrier, i.e. the new home carrier is located in the region to which the mobile unit has roamed. The reassigned NAM will be local to the current home system which is determined by the uploaded site identification number (SID). The SID is used to identify specific cellular carrier systems.

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L26: Entry 7 of 51

File: USPT

Aug 31, 1999

DOCUMENT-IDENTIFIER: US 5946623 A

TITLE: System and method for routing a wireless telecommunications call

DATE FILED (1):19960301Abstract Text (1):

This invention provides a system and method for routing a call from a wireless telecommunications unit for service and information. The system and method are especially useful and effective for service and information calls from wireless telecommunications that are roaming outside their home service areas. The invention allows a user of a wireless telecommunications unit to input a predetermined code, into the unit and to be connected automatically to a home service location associated with the unit. The system of the present invention includes a wireless telecommunications unit, a telecommunications system serving that unit, a routing system and means for establishing an end-to-end communications path between the wireless telecommunications unit and the home service location. The system of the present invention may also include means for informing the home service location of the location of the wireless telecommunications unit. The method of the present invention includes the steps of inputting a predetermined code into a wireless telecommunications unit; transmitting to a telecommunications system serving the unit a signal corresponding to the predetermined code and information that identifies the unit and associates the unit with a home service location; transmitting the unit identification information to a routing system; evaluating the identification information according to predetermined criteria, such as whether the home service location is served by the routing system; and, if the unit identification information meets the predetermined criteria, establishing an end-to-end communications path between the wireless telecommunications unit and the home service location.

Brief Summary Text (6):

A user of wireless telecommunications services usually receives the service by contracting with a service provider that operates a wireless telecommunications system. The system with which the user contracts or subscribes is typically known as the user's home wireless telecommunications system. This home system for example may provide the subscriber with access to the wireless telecommunications service, and may provide a wide variety of services such as billing and collection for wireless telecommunications services; arrangements for telecommunications services such as long distance services or others interconnected with the home wireless system; assistance with the operation of the subscriber's wireless telecommunications unit; information on rates, system coverage, dialing patterns, and billing issues; and guidance on how to obtain various services in connection with the system serving the wireless telecommunications unit. The service location could also function as a corporate communications center or a gateway between the wireless telecommunications unit user and a broad range of telecommunications and information services.

Brief Summary Text (7):

In many applications, a home wireless telecommunications system provides wireless telecommunications services in a geographic area. In cellular telecommunications in the United States, for example the geographic areas served by cellular systems approximately correspond to Metropolitan Statistical Areas as determined by the Bureau of the Census and as set forth in the rules of the Federal Communications Commission. In personal communications services in the United States, as another example, system service areas approximately correspond to Metropolitan Trading Areas or Basic Trading

Areas as set forth in the rules of the Federal Communications Commission, depending on the frequency band used for the wireless portion of the service.

Brief Summary Text (8):

A home wireless telecommunications system typically provides subscribers with the ability to establish a communications path between the subscriber's wireless telecommunications unit and a telecommunications switch included in the home system's facilities. This communications path typically includes a wireless telecommunications path between the subscriber's wireless telecommunications unit and a fixed station, usually known as a base station. In a two-way wireless communications system, such as a cellular mobile telephone system, a base station receives wireless communications from and transmits wireless communications to the subscriber's wireless telecommunications unit. The base station also interconnects with other telecommunications facilities to establish a communications path between the wireless telecommunications unit and the telecommunications switch. The telecommunications switch of the system, in turn, may be connected to other communications facilities to establish communications paths between the wireless telecommunications unit, in some cases via the home system telecommunications facilities, and other telecommunications units--wireless or non-wireless, mobile or fixed--operating within the home telecommunications system or in connection with other telecommunications systems. These other telecommunications systems could include, by way of example, local exchange or other wireless telecommunications systems operating in the same geographic area served by the home wireless system, as well as telecommunications systems operating in other areas of the same country or in other countries.

Brief Summary Text (9):

When a wireless telecommunications unit is operated in a geographic area outside the area served by its home system, it is typically said to be roaming. In order for roaming to occur, a system in whose geographic area the wireless telecommunications unit is operating, and which is capable of communicating with the unit, must agree to provide service to the wireless telecommunications unit. This agreement may be reached, for example, when the user of the unit attempts to make a call in an area outside the unit's home system. In this example, when a wireless telecommunications unit is activated, for instance when a "send" key is depressed, the unit transmits information that identifies the individual unit as well as the unit's home system. The system serving the unit, sometimes referred to as the foreign system or serving system, receives this identifying information, recognizes that the unit is roaming, and either directs the user to call another number in order to establish a basis for paying the charges for the call, or diverts the call to a destination with which the user can communicate in order to establish a basis for paying the charges for the call. Such bases may include billing the charges for the call to a credit card account, a calling card account, a third-party number, or to the number being called (i.e., a collect call). These are some of the ways in which the wireless telecommunications system serving the wireless telecommunications unit can be assured that it will be compensated for its charges for handling calls originated by roamers.

Brief Summary Text (10):

Another approach to handling roamers is for the foreign system serving the wireless telecommunications unit to have a roaming agreement with the home telecommunications system of the wireless telecommunications unit. In this approach, when the roaming wireless telecommunications unit attempts to make a call, the foreign system handles the call as if it were the home system for the wireless telecommunications unit--that is, there would be no interception or diversion of the call. The foreign system serving the wireless telecommunications unit would, for example, bill its appropriate charges to the home telecommunications system, which would then charge the subscriber through the home-system billing process.

Brief Summary Text (11):

Problems may still arise, however, when a roaming user of a wireless telecommunications unit attempts to make a call. For example, the dialing pattern for making long distance or collect calls may be different in the subscriber's home system than in the foreign system.

Brief Summary Text (12):

These problems may be compounded in the context of calls for service or information.

Such calls may be prompted for example by a user's difficulty in using a foreign system, by difficulties in operating a wireless telecommunications unit, by questions about service features and options, by questions about charges and billing arrangements, by the need to access other telecommunications or information services, and the like. In some cases, the number to dial for service or information in the foreign system may be different from the number to dial for service or information in the home system of the wireless telecommunications unit. Even if the numbers to call are the same in the foreign and home systems, the service or information personnel of the system serving the wireless telecommunications unit may not be familiar with the particular wireless telecommunications unit being used by the subscriber. In addition, the foreign system may have been directed by the wireless telecommunications unit's home system to limit or deny service to the unit for example because of concerns about fraudulent calls from the unit or billing issues between the home system and the unit's subscribers. In such cases, the service personnel of the foreign system may not be familiar with the reasons for the limitations or denial of service. Indeed, it would be unlikely for the service or information personnel of the foreign system serving the roaming unit to have the same information about the roaming subscriber, such as the subscriber's billing history or service options and preferences, that service or information personnel of the subscriber's home system would have readily available in responding to a service or information call.

Brief Summary Text (13) :

In addition, even if the call for service or information by a roaming user were successfully routed to a service or information location associated with the home system of the wireless telecommunications unit, the home system service or information location typically is not informed of the location of the wireless telecommunications unit. As a consequence, the home system service or information location would not for example know the identity of the wireless telecommunications system serving the wireless telecommunications unit, and thus may not have full information about the circumstances, such as difficulty with the dialing pattern for a long distance or other kind of call, that gave rise to the call for service or information.

Brief Summary Text (15) :

An object of the invention is to provide a system and method for facilitating service or information, or both, for wireless telecommunications subscribers.

Brief Summary Text (18) :

Another object of the invention is to provide a system and method for informing a service location associated with a roaming wireless telecommunications unit calling for service or information of the geographic location of the wireless telecommunications unit.

Brief Summary Text (19) :

The present invention, as broadly described herein, provides a system comprising a combination of elements for routing a wireless telecommunications call including a wireless telecommunications unit, a telecommunications system serving the wireless telecommunications unit, a routing system, and a means for establishing an end-to-end communications path between the wireless telecommunications unit and a home service location associated with the wireless telecommunications unit. The invention allows a user of the wireless telecommunications unit to input a predetermined code such as "\*611" into the wireless telecommunications unit and to be connected with the home service location associated with the unit. As broadly described herein, the system of the present invention may also include means for informing the home service location of the location of the wireless telecommunications unit.

Brief Summary Text (20) :

The present invention, as broadly described herein, also provides a method for routing a wireless telecommunications call, including the steps of inputting a predetermined code into a wireless telecommunications unit; transmitting to a telecommunications system serving the unit a signal corresponding to the predetermined code and information that identifies the unit and associates the unit with a home service location; transmitting the unit identification information to a routing system; evaluating the identification information according to predetermined criteria, such as whether the home service location is served by the routing system; and, if the unit identification information meets the predetermined criteria, establishing an

end-to-end communications path between the wireless telecommunications unit and the home service location. As broadly described herein, the method of the present invention may also include the step of signalling the home service location with information on the location of the wireless telecommunications unit.

Detailed Description Text (8) :

The predetermined code is a code to be input into the WTU in order to signal that the user of the WTU desires to call a service location. In a preferred embodiment, the predetermined code is the symbol \*611, and is the number recognized by at least the telecommunications system serving WTU 10 for calls for service from roamers. Such service could include, by way of example, assistance with dialling patterns in order to make calls of various types such as calls to other users of the telecommunications system serving the WTU and calls to users of other telecommunications systems; assistance with service options and preferences; assistance with the use and operation of the WTU equipment; assistance with charges and billing for wireless telecommunications services; assistance with fraud control; assistance with access to various telecommunications and information services; information on services, features, charges and billing; information on the reasons for service limitations or denial; or any other reason why a user of a wireless telecommunications unit might want or need to reach a home service location.

Detailed Description Text (11) :

In the preferred embodiment depicted in FIG. 1, WTU 10 is equipped with radio transmitting and receiving means, such as a radio transceiver or other wireless telecommunications technology known in the art, which provides means for generating a signal corresponding to the predetermined code and to WTU identification information associated with WTU 10, and means for transmitting that signal. The means for generating such a signal are known in the art. The WTU identification information associates WTU 10 with a home service location, and preferably is designed to identify WTU 10 uniquely. In a cellular mobile telecommunications system, for example, the WTU identification information could be the mobile identification number of WTU 10. In other wireless telecommunications services, conventions have been developed for identifying subscriber units, and these conventions could provide the basis for developing WTU identification information for each WTU in such other services.

Detailed Description Text (15) :

In a preferred embodiment, serving system 20 includes digital computer means or other means known in the art for determining, by evaluating the WTU identification information, whether serving system 20 is the home telecommunications for WTU 10, or whether WTU 10 is roaming--that is, operating in a telecommunications system other than the home system of WTU 10. If serving system 20 determines that it is the home system of WTU 10, then serving system 20 would for example route the call from WTU 10 for service to the service location for subscribers of serving system 20. If, on the other hand, serving system 20 determines that it is not the home system of WTU 10, then, in a preferred embodiment, serving system 20 would transmit the WTU identification information to a routing system.

Detailed Description Text (16) :

In an alternate preferred embodiment, serving system 20 routes all calls with the predetermined code--including those made by for whom serving system 20 is a home system--to the routing system. In essence, the serving system would be treating all calls with the predetermined code as calls from roamers. Calls with the predetermined code from a wireless telecommunications unit for which serving system 20 is a home system would then be routed by the routing system to the home service location associated with that wireless telecommunications unit.

Detailed Description Text (18) :

In an alternate preferred embodiment, serving system 20, responsive to the predetermined code, transmits the predetermined code and the WTU identification information to the routing system. The user of WTU 10 thus could signal the routing system, via serving system 20, to route the call to different home service locations, depending on the predetermined code.

Detailed Description Text (21) :

The routing system 30 means for evaluating the WTU identification information

according to predetermined criteria may comprise digital computers or other technology known in the art for such functions. In the preferred embodiment depicted in FIG. 1, the evaluation means in routing system 30 may evaluate the WTU identification according to whether WTU 10 is subscribed to a telecommunications system with which routing system 30 is connected for the purpose of routing wireless calls with the predetermined code to a home service location. The evaluation means of routing system 30 preferably searches a database to determine the home service location associated with WTU 10. In the preferred embodiment depicted in FIG. 1, the evaluation means of routing system 30 determines whether WTU 10 is associated with home service location 40, and, if so determines the means for establishing an end-to-end path between WTU 10 and home service location 40.

Detailed Description Text (22) :

In the preferred embodiment depicted in FIG. 1, home service location 40 is associated with a home telecommunications system, depicted in FIG. 1 as home system 42 having mobile telephone switching office 44. In this embodiment, routing system 30 determines that WTU 10 is associated with home system 42, and includes means for establishing a communications path between routing system 30 and mobile telephone switching office 44 and interconnecting that path with a communications path between mobile telephone switching office 44 and routing system 30. In a preferred embodiment not depicted in FIG. 1, the routing system, responsive to an evaluation of the WTU identification information (and other information such as the predetermined code transmitted to the routing system), signals the telecommunications serving the WTU to establish a communications path between the WTU and the home service location that does not utilize any routing system facilities. With reference to FIG. 1, as an example of this embodiment, routing system 30 would, responsive to WTU identification information transmitted by mobile telephone switching office 24, signal mobile telephone switching office 24 to establish a direct communications path between mobile telephone switching office 24 and mobile telephone switching office 44. In such embodiments, routing system 30 functions primarily as a database that is queried by appropriate facilities of serving system 20 in order to ascertain how the same or other facilities of serving system 20 should route the call.

Detailed Description Text (23) :

In a preferred embodiment, the routing system also comprises means for signalling the telecommunications system serving the WTU of the evaluation of the WTU identification information according to the predetermined criteria. For example, in the preferred embodiment depicted in FIG. 1, routing system 30 would signal serving system 20 whether WTU 10 is associated with a home service location for which routing system 30 is able to establish an end-to-end path with WTU 10. If, for example, routing system 30 were not able to establish such an end-to-end path, then it would so signal serving system 20, which could then in turn perform a variety of functions, such as signalling WTU 10 that the call for service could not be completed, or routing the call to a service location associated with serving system 20. In an alternate preferred embodiment, if routing system 30 is not able to establish the end-to-end communications path, routing system 30 signals serving system 20 to signal WTU 10 to input additional information in order to enable routing system 30 to perform its functions.

Detailed Description Text (26) :

In the preferred embodiment depicted in FIG. 1, the home service location is home service location 40. In this preferred embodiment, home service location 40 is associated with a home telecommunications system. This home telecommunications system would be the system to which WTU 10 is regularly subscribed for service, and may for example bill a designated customer for usage by WTU 10 of services provided by its home telecommunications system, as well as for example services provided by other telecommunications providers with which home system 42 has a billing and collection arrangement. In a preferred embodiment, home service location 40 would be equipped to provide service to a user of WTU 10, including, for example, information on the wireless service options selected by the user; information on the features such as call-waiting, call-forwarding and conference-calling utilized by the user; information on the user's arrangements with long distance and other telecommunications services to be used in connection with the user's wireless telecommunications services; information on the operation of WTU 10; information on the user's credit; information and access to services in the foreign market in which WTU 10 is operating (such as how

- to reach emergency medical or public safety services); information on and access to other telecommunications and information services offered through the foreign system or otherwise; information on the coverage of the foreign system serving WTU 10; information on service limitations or denials imposed by the foreign system in which WTU 10 is operating; implementation of service restrictions or termination desired by the user of WTU 10; and any other services or information that would prompt a user of WTU 10 to call a service or information location. Home service location 40 could include automated answering devices, human operators and other means known in the art for providing service and information to users of telecommunications services.

Detailed Description Text (27) :

As depicted in FIG. 1, the home telecommunications system of WTU 10 is home system 42. As further depicted in FIG. 1, home service location 40 is located within the geographic service area of home telecommunications service 42. In an alternate embodiment not depicted in FIG. 1, home service location 42, while associated with home system 42, is located outside the geographic service area served by home system 42. In another alternate embodiment, home service location 40 may not be associated with any telecommunications system, but may rather be an independent service location that has information, for example as a result of contractual arrangements, sufficient to provide service or information to the user of WTU 10. Thus, for example, routing system 30 could route a call from WTU 10 to different service locations, depending on the predetermined code input into WTU 10 and the information transmitted from serving system 20 to routing system 30. As another example, routing system 30 could provide for different routings of a call from WTU 10 to the same home service location depending on any number of factors, such as the time of day and traffic volumes on particular communications paths. As a further example, based on the WTU identification information of each wireless telecommunications unit, routing system 30 could provide different routings for calls to the same home service location from different wireless telecommunications units operating in the same foreign telecommunications system, again depending on relevant call routing factors and service priorities and billing arrangements associated with individual wireless telecommunications units.

Detailed Description Text (29) :

In the preferred embodiment depicted in FIG. 1, an end-to-end communications path is established, responsive to the evaluating means of routing system 30, between WTU 10 and home service location 40. In a preferred embodiment, the end-to-end communications path would comprise an originating communications path between WTU 10 and telecommunications switching means of serving system 20, as well as a home-service communications path between the telecommunications switching means of serving system 20 and home service location 40. As indicated above, these communications paths could be established using any technology or combination of technologies known in the art for establishing communications paths.

Detailed Description Text (30) :

As depicted in FIG. 1, the end-to-end communications path comprises an originating communications path between WTU 10 and mobile telephone switching office 24, via base station 22, both of serving system 20. As also depicted in FIG. 1, the end-to-end communications path comprises a home-service path between mobile telephone switching office 24 of service system 20 and home service location 40.

Detailed Description Text (31) :

In a preferred embodiment in which the home service location is associated with a home telecommunications system, the home-service communications path may comprise an intersystem communications path between the system serving WTU 10 and the home telecommunications system. In the preferred embodiment depicted in FIG. 1, an intersystem communications path is established, responsive to the evaluation by routing system 30 of the WTU identification information, via routing system 30 between mobile telephone switching office 24 of serving system 20 and mobile telephone switching office 44 of home system 42, as part of the end-to-end communications path. In such an embodiment, the end-to-end communications path between WTU 10 and home service location 40 also includes a terminating communications path between mobile telecommunications switching office 44 and home service location 40. The configuration and technology of a terminating communications path would be selected based on factors known in the art depending on the configuration, location and functions of home service location 40 and the facilities used in home system 42.

Detailed Description Text (32) :

In another preferred embodiment, a home-system communications path includes a first routing-system path between the telecommunications system serving WTU 10 and the routing system, and a second routing-system path between the routing system and the home telecommunications system, and the routing system includes switching means for interconnecting the first routing-system path and the second routing-system path. In the preferred embodiment depicted in FIG. 1, for example, in order to establish an end-to-end communications path between WTU 10 and service location 40, in response the evaluation by routing system 30 of the WTU identification information, an originating communications path is established between WTU 10 and mobile telephone switching office 24, via base station 22 of serving system 20; a first routing-system communications path is established between mobile telephone switching office 24 and routing system 30; a second routing-system communications path would be established between routing system 30 and mobile telephone switching office 44 of home system 42; and a terminating communications path would be established between mobile telephone switching office 44 and home service location 40.

Detailed Description Text (34) :

In a further preferred embodiment, the system for routing wireless telecommunications calls of the present invention also includes means for providing a home service location with additional information, such as the identity of serving system 20 and the geographic location of WTU 10. By providing such information to the home service location, the system of this embodiment provides the home service location with additional capability to respond to needs and questions of the user of the WTU. The user may, for example, need information on the availability and price of various services of the wireless telecommunications system serving the WTU, or the dialing patterns required to use those services, and knowledge of the system serving the WTU or the geographic location of the WTU, or both, would facilitate the provision of this dialling pattern information.

Detailed Description Text (35) :

In the preferred embodiment depicted in FIG. 1, mobile telephone switching office 24 transmits information identifying serving system 20 to routing system 30 contemporaneously with the transmission of the WTU identification information to routing system 30. Responsive to the evaluation of the WTU identification information by routing system 30, routing system 30 also transmits the information identifying serving system 20 to mobile telephone switching office 44, which passes it on to home service location 44 along with the WTU identification information. Means for identifying serving system 20 are known in the art, and include by way of example dialed number information and toll-free number information associated with serving system 20 when a communications path is established between serving system 20 and routing system 30. Home service location 40 is thus informed that serving system 20 is serving WTU 10, and can also use this information to determine the approximate geographic location of WTU 10. In an alternate embodiment, mobile telephone switching office 24 determines that an originating communications path has been established between WTU 10 and base station 22, and signals routing system 30 with the identity of base station 22 and its geographic location. This geographic location information is transmitted to home service location 40 via a home-service communications path, such as depicted in FIG. 1, so that home service location 40 has more precise information on the location of WTU 10. In another preferred embodiment not depicted in FIG. 1, WTU 10 signals a geographic position determination system using global satellite positioning or other position determining technology, which signals home service location 40, either directly or indirectly, with a precise geographic location of WTU 10.

Detailed Description Text (38) :

In the preferred embodiment depicted in FIG. 2, the inputting step is accomplished by the user dials \*611 step 100. This step would be accomplished using a WTU, such as WTU 10 depicted in FIG. 1 or other wireless telecommunications units known in the art. As described above with reference to FIG. 1, the predetermined code \*611 preferably is widely known and used for calls by subscribers for calls for service or information. As also described with reference to FIG. 1, other predetermined codes may be used.

Detailed Description Text (39) :

In the preferred embodiment depicted in FIG. 2, the WTU transmits signal step 120 accomplishes the step of transmitting, from the WTU to a telecommunications system serving the WTU, a signal corresponding to the predetermined code and WTU identification information associated with the WTU that also associates the WTU with a home service location. The conversion from the predetermined code to a signal corresponding to that code and the WTU identification information is accomplished by wireless telecommunications unit technology known in the art. The WTU identification associates the WTU with a home service location. As described above in connection with FIG. 1, the WTU identification information may also uniquely identify the WTU as well as the home telecommunications system associated with the WTU.

Detailed Description Text (42):

In the preferred embodiment depicted in FIG. 2, the step of evaluating the WTU identification information according to predetermined criteria is undertaken at the evaluate WTU identification information step 140. This evaluation may be undertaken at routing system 30 or mobile telephone switching office 24 depicted in FIG. 1, or at another facility or facilities where technology for performing such evaluations may be located. In a preferred embodiment, this evaluate WTU identification information step 140 utilizes a computerized database to determine whether the WTU is subscribed to a wireless telecommunications system with which the routing system is able to establishing a communications path so that the call for service from the WTU may be routed to the home telecommunications system of the WTU.

Detailed Description Text (43):

In the preferred embodiment in a cellular mobile telephone system, the WTU is a cellular mobile unit, the routing system is operated by an interexchange carrier and the WTU identification information is the Mobile Identification Number ("MIN") of the cellular mobile unit. The routing system checks the MIN against a database including the ranges of MINs of wireless telecommunications systems with which the interexchange carrier has agreements to handle calls from roaming cellular subscribers using the predetermined code to reach a home service location associated with their home telecommunications system. If the MIN falls within these ranges, then the WTU identification information would meet the predetermined criteria.

Detailed Description Text (45):

In the preferred embodiment depicted in FIG. 2, if the WTU identification information meets the predetermined criteria, then the establish end-to-end path step 150 accomplishes the step of establishing an end-to-end communications path between the WTU and the home service location associated with the WTU. As depicted in FIG. 1, this end-to-end communications path is comprised of interconnected paths between WTU 10 and base station 22 of serving system 20, between base station 22 and mobile telephone switching office 24 of serving system 20, between mobile telephone switching office 24 and routing system 30, between routing system 30 and mobile telephone switching office 44 of home system 42, and between mobile telephone switching office 44 and home service location 40. As described above in connection with FIG. 1, other technologies known in the art may be used to establish an end-to-end communications path between the WTU and the home service location.

Detailed Description Text (47):

In a further preferred embodiment, the serving system transmits WTU identification information step 130 also includes the step of transmitting additional information, such as the identity of the telecommunications system serving the WTU, or the geographic location of the WTU, or both. In this preferred embodiment, if the WTU identification information meets the predetermined criteria, this additional information would also be transmitted to the home service location, thereby providing personnel and facilities at the home service location with potentially important information in responding to the call from the WTU to the home service location. Technologies for implementing the step of transmitting additional information are known in the art and include the technologies for this purpose described in connection with FIG. 1.

Detailed Description Text (48):

The establish end-to-end path step 150 depicted in FIG. 2 may also include the establishment of various interconnected communications paths which together form an end-to-end communications path. For example, the establish end-to-end path step 150

may include establishing an originating communications path between the WTU and telecommunications switching means of the telecommunications system serving the WTU, and a home-service communications path, interconnected with the originating communications path, between the telecommunications switching means of the telecommunications system serving the WTU and the home service location. The home-service communications path may in turn comprise a series of interconnected communications paths, for example an intersystem communications path between the telecommunications switching means of the system serving the WTU and telecommunications switching means of a home telecommunications system with which the home service location is associated; and a terminating communications path between the telecommunications switching means of the home system and the home service location. In an alternative embodiment, such as depicted in FIG. 1, the intersystem communications path comprises a first routing-system path between the telecommunications switching means of the telecommunications system serving the WTU and the routing system, interconnected with a second routing-system communications path between the routing system and the telecommunications switching means of the home telecommunications system.

CLAIMS:

18. The system as set forth in claim 1, wherein the end-to-end voice communications path comprises a home-service voice communications path between the telecommunications system serving the WTU and the home service location.

19. The system as set forth in claim 18, wherein the WTU identification information associates the WTU with a home telecommunications system associated with the home service location, and wherein the home-service voice communications path comprises an intersystem voice communications path between the telecommunications system serving the WTU and the home telecommunications system.

20. The system as set forth in claim 19, wherein the home-service voice communications path comprises a terminating voice communications path between the home telecommunications system and the home service location.

21. The system as set forth in claim 18,

wherein the home-service voice communications path comprises a first routing-system voice communications path between the telecommunications system serving the WTU and the routing system and a second routing-system voice communications path between the routing system and the home service location; and

wherein the routing system further comprises switching means for interconnecting the first routing-system voice communications path and the second-routing system voice communications path.

22. The system as set forth in claim 1, wherein the WTU identification information associates the WTU with a home telecommunications system associated with the home service location.

23. The system as set forth in claims 19, 20, 21 or 22, wherein the home service location is located within a geographic area served by the home telecommunications system.

24. The system as set forth in claims 19, 20, 21 or 22, wherein the home service location is located outside a geographic area served by the home telecommunications system.

25. The system as set forth in claim 1, further comprising means for signalling the home service location with additional information concerning the WTU.

26. The system as set forth in claim 25, wherein the additional information signalling means comprises means for signalling the home service location with information identifying the telecommunications system serving the WTU.

47. The method as set forth in claim 32, wherein the step of establishing the

- end-to-end voice communications path further comprises the step of establishing a home-service voice communications path between the telecommunications system serving the WTU and the home service location.

48. The method as set forth in claim 47, wherein the WTU identification information associates the WTU with a home telecommunications system associated with the home service location, and wherein the home-service voice communications path comprises and intersystem voice communications path between the telecommunications system serving the WTU and the home telecommunications system.

49. The method as set forth in claim 48, wherein the step of establishing the home-service voice communications path further comprises the step of establishing a terminating voice communications path between the home telecommunications system and the home service location.

50. The method as set forth in claim 47, wherein the step of establishing a home-service voice communications path further comprises the steps of

establishing a first routing-system voice communications path between the telecommunications system serving the WTU and the routing system; and

establishing a second routing-system voice communications path between the routing system and the home service location;

wherein the routing system further comprises switching means for interconnecting the first routing-system voice communications path and the second routing-system voice communications path.

51. The method as set forth in claim 32, wherein the WTU identification information associates the WTU with a home telecommunications system associated with the home service location.

52. The method as set forth in claim 32, wherein the home service location is located within a geographic area served by the home telecommunications system.

53. The method as set forth in claim 32, wherein the home service location is located outside of a geographic area served by the home telecommunications system.

55. The method as set forth in claim 54, wherein the additional information signalling step comprises the step of signally the home service location with information identifying the telecommunications system serving the WTU.

56. The method as set forth in claim 54, wherein the additional information signalling step comprises the step of signalling the home service location with information identifying the telecommunications system serving the WTU.

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TITLE: Method and system for updating replicated databases in foreign and home telecommunication network systems for supporting global mobility of network customersDATE FILED (1):19940913Abstract Text (1):

A method and system of the present invention updates a replicated database in a foreign telecommunication network system situated in a foreign region and a home country telecommunication network system situated in a home country. The method and system improves call setup time and system availability in a foreign region for customers roaming outside their home country. Customer records are updated in a visitor database contained in a foreign region within the signaling system of foreign telecommunications network. Information concerning the updated database record is transmitted from the visitor database through the signaling network of a home country to a home database which contains the replicated version of the visitor database record in the foreign region. A field is added to the database record corresponding to a version number of the database record so as to identify the record referenced by queries of calls in progress. The home database record at the home country is changed to reflect changes in the visitor database at the foreign region by using the version number sequence while maintaining at all database sites the older version of the database record for query access until after completing the processing of all previous call querying the database record.

Brief Summary Text (2):

This invention relates to a method and system for updating replicated databases in a foreign and home telecommunication network system to improve call setup time and system availability to support global mobility of network customers in foreign regions.

Brief Summary Text (4):

In the increasingly smaller world brought together by telecommunication networks, it is desirable to globalize a telecommunication network without building expensive transport networks in foreign countries. In fact, some countries will not allow domestic United States companies to enter their foreign countries to build such networks. Other expansive proposals for supporting global mobility include using satellites for locating mobile customers throughout the world. This design would be expensive.

Brief Summary Text (5):

No matter what type of global system is used, however, for certain mobile customers, the number of queries and updates corresponding for one record of a database would increase dramatically. Thus, it would be advantageous to distribute and replicate customer records in multiple geographical locations, i.e., sites, of various signaling networks of foreign countries for easy access, achieving a high level of efficiency and system availability as well as improved call setup time.

Brief Summary Text (7):

The features and advantages of the present invention overcome the drawback of building expensive call transport systems in foreign countries. The system can be used with both wireless and wired networks of foreign countries.

Brief Summary Text (8) :

In accordance with the present invention, a method and system for updating replicated databases in foreign and home telecommunication network systems to improve call setup time and system availability in a foreign region for roaming home network customers is disclosed. A foreign region has a call transport system and switches for forwarding calls from a telecommunication station through the call transport system to a destination. A signaling system is operatively connected to the call transport system and includes a visitor database within the signaling system containing customer records for call routing and other signaling functions.

Brief Summary Text (9) :

A home signaling system of a home country has a home database. The visitor database is connected to the home signaling system. A customer record is updated in the visitor database. Information concerning the updated database record is transmitted through the home signaling network to the home database containing the previous version of the database record. Means is responsive to the completion of all calls querying the previous version of both the visitor and home database record for deleting the previous version of the database record.

Brief Summary Text (10) :

Queries are launched to the home database when calls are originated from the home country to network customers in the foreign region. Queries are launched to the visitor database when calls originate from the foreign region to a network customer. In one aspect of the invention, current location information in the visitor database is maintained for highly mobile customers traveling in a foreign region. Identifiers contained within the home database directing calls to the visitor database for queries. The use of identifiers contained in the home database lessens the amount of constant updating to the home database.

Brief Summary Text (12) :

Multiple versions of customer records can be maintained in the visitor and home databases so that queries for a call could access the same version of the associated record for consistent routing and signaling information. Each updated record may include a version number of the record so as to identify the record referenced by queries of calls in progress. Records in the home database are updated by the version number sequence of the updated database records. Each version of a record includes a call counter field for indicating the number of ongoing calls whose queries have previously accessed that version of the record. The call counter field is incremented if a new call references to it and decrements the call counter field when a call setup is completed. The previous version of the database record is deleted when the call counter is zero.

Detailed Description Text (3) :

In accordance with the present invention, a customer record is updated in a primary site database within the signaling system of a telecommunication network, which includes a call transport system with switches for forwarding calls from a local telephone station through the call transport system to a destination. The information concerning the updated database record is transmitted through the signaling network to at least one secondary site database which contains the previous replicated version of the primary site database record. The customer record is changed at the secondary site to reflect changes in the database at the primary site. The older versions of the record are maintained at both primary and secondary site databases for query access until after completing the processing of all previous calls querying the versions of the record at the database site.

Detailed Description Text (6) :

FIG. 1 illustrates an intelligent network, shown generally at 10, having a transport network, indicated generally at 12, and signaling network such as the common SS7 network 14. The transport network 12 includes a wired network 20, and could include a wireless network 16 for mobile units 22. The transport network 12 connects to the local central office 23 and the local telephone station 24.

Detailed Description Text (9) :

Since the distributed database issues are common to the PCN, the UPT services, and possibly other services involved in the use of databases (e.g., Network Control

Points, NCPs) in the IN, the general terminology for distributed database systems is adopted in the following specification. The computer system 30, 30a for respective primary and secondary sites where parts of the database are located is referred to hereafter as sites. Customer records for call routing, features, service profiles, and other signaling information are called records. Reads and writes to the database are also referred to as queries and updates, respectively. To enable recovery from system failures (except disk crashes), each site keeps a log (also known as journal) of all updates made to the local database in a stable memory 36, 36a which can survive the failures.

Detailed Description Text (10):

In accordance with the present invention used with telecommunication services, the database 26a consists of a collection of individual records, which are distributed and replicated at multiple sites, such as the secondary site database 28a. Queries associated with a call, and updates for a customer, access a particular record in the database. Thus, the readset and writeset of a query and an update are one record. As a result, if queries and updates are processed atomically, unnecessary data inconsistency can be avoided.

Detailed Description Text (11):

Furthermore, several queries may be launched to access the associated record during the call setup time, which typically lasts several seconds. Although the record may have been updated in the meantime, it is advantageous not to immediately remove an obsolete copy of the record so that subsequent queries of the calls in progress can be processed in a consistent way according to the previous record. This eliminates the need for locking records for query processing without being concerned about data inconsistency. Additionally, calls will not be mishandled while the customer's record is updated. This would be more difficult if the readset and writeset of queries and updates consisted of many records and files, as in the database systems of other applications.

Detailed Description Text (13):

Since the readset (or writeset) of each query (or update) is one record, the concurrency control protocol must only maintain the internal and mutual consistency at the record level. With internal consistency, data items in each record at every site are always consistent. For example, the routing data in a record must be valid so that calls can be routed properly. Mutual consistency is preserved, if copies of a record replicated at different sites become identical in a finite amount of time after a number of updates have been posted to the record. The commitment protocol is designed to enable the system to recover from system failures, i.e., those updates that have been committed will not be undone. As illustrated below, the present invention provides a single protocol which performs the concurrency control and the commitment functions.

Detailed Description Text (16):

b. Records of the database 26a are distributed and replicated at the sites. For example, a record (record A) is replicated at N sites, indexed by  $i=1, 2, \dots, N$ . To take advantage of load balancing, the initial queries of calls requiring access to record A are sent to those N sites according to some call distribution algorithm known to those skilled in the art, such as the generalized round-robin algorithm, or a static scheme. To avoid unnecessary data inconsistency if a call setup involves multiple queries to the same record, subsequent queries of a call are routed to the same site where the initial query of the call is processed.

Detailed Description Text (17):

c. Each site 26, 28 can keep multiple versions of a record so that queries for a call can access the same version of the associated record for consistent routing and other signaling information. An obsolete version of the record is deleted after the process of all calls querying it has been completed.

Detailed Description Text (21):

To ensure the correct operations of the protocol, two fields are added to each record: 1) a version number (VN) and 2) a call counter (CC). The version number is used to identify the version of a record referenced by queries of calls in progress, while the call counter indicates the number of ongoing calls, that have previously accessed that

version of the record. If the call counter is zero, and the record has been updated, the older version of the record is deleted. At any given time, there are probably very few (e.g., two) versions of the same record existing at a site because all setup time lasts only a few seconds and inter-update time is typically much longer than that.

Detailed Description Text (23):

If the query for record A is the first query of a call, then

Detailed Description Text (40):

The system allows non-identical copies of records replicated at different sites to be available for call processing simultaneously. Thus, queries may access the obsolete information at some secondary sites while updates are pending for processing, thus causing call misroutes. As discussed before, if the probability of such occurrence is satisfactorily small, exclusive access to the records during updates is not needed. Without exclusive access, the system 10 is deadlock free.

Detailed Description Text (47):

A fraction of calls may be misrouted by the method of the present invention because of accessing obsolete information at some secondary site databases, while updates are pending. The fraction of calls misrouted is a key performance measure for determining whether or not the method of the present invention is applicable to a particular application.

Detailed Description Text (50):

Based on a performance study with typical parameters in today's telecommunication networks, results in FIGS. 5-7 show that the fraction of calls misrouted under the method of this invention is satisfactorily small (e.g., less than 10.sup.-4) for a wide range of expected customer behavior (in term of call throughput and ratio of record read-write frequencies R.sub.q) in the Personal Communication Networks (PCN), wireless networks, Universal Personal Telecommunication (UPT) services and other advanced services to be offered by the Intelligent Networks (IN).

Detailed Description Text (53):

As shown in block 100, the customer record at the primary site is first updated. The update is then checked for any data inconsistency in block 102. If there is an inconsistency, the update program is terminated in block 104. If there is no data inconsistency, the update is then processed in block 106 and a new version of the record is created in block 108. The updated is committed in the log in block 110. The information relating to the update is then transmitted to databases at secondary sites in block 112. The secondary site updates by using the version number in block 114. Secondary site then creates a new version of the record in block 116. The update is committed in the log at the secondary site in block 118. If the call counter of the last version of the record is zero in block 120, then the old database record is deleted in block 122. Regardless whether the call counter is zero or not, the secondary site sends an acknowledgement to the primary site as the update has been successfully processed in block 124. The process continues with the next update in block 126.

Detailed Description Text (57):

The current approach to supporting the terminal mobility requires a home database (or Home Location Registers, HLR) and a visitor database (or Visitor Location Registers, VLR). This HLR-VLR architecture actually has been established as an industry standard in the Global System for Mobile Telecommunications (GSM) for Europe and the IS-41 recommendations for North America. The home database can accessed by the fixed, wired or wireless network, whereas the visitor database is connected to a switch (referred to as the mobile switching center, MSC) in the wireless network. The routing and other signaling functions of each call initiated from or destined for a mobile customer requires the use of the location information stored in the databases. The protocol and the associated architecture for supporting the terminal mobility are well defined, and understood by those skilled in the art.

Detailed Description Text (62):

1. Customers traveling abroad have to register from the visited country so that the network is informed of their current locations (e.g., in terms of POTS numbers in wired networks, or mobile station roaming numbers in wireless networks). This location

information for all customers subscribing to the UPT services is stored in the centralized database, which can be supported by a Network Control Point, NCP. Signal transfer points 204 in the U.S. network communicate with signal transfer points 206 in country 1, and any other country in 210. Country 1 includes a VLR 212 connected to a MSC 214 in the wireless network 216. Country 1 also includes a wired network 218. Country n also includes similar elements referenced by prime notation.

Detailed Description Text (66) :

3. When a call is destined for a UPT customer located either in the U.S. or abroad, the signaling network queries the centralized database 200 for the location information for call setup and other signaling functions.

Detailed Description Text (81) :

The replicated database design is compatible with the industry standards such as the IS-41 and the GSM specifications for wireless networks. The visitor database in a region can be treated as the HLR by the wireless network in the visited country. The rest of the standardized protocols for wireless networks remain applicable. Upon receiving updates from a local wireless network, the visitor database is responsible for forwarding the updates to the home database in the U.S. to ensure customer data consistency in the home and visitor databases. Hence, the replicated database design indeed applies not only to wired services but also to wireless services.

Detailed Description Text (87) :

A mobile, wireless customer is roaming in a foreign country. As a customer moves from one location area to another, the customer location information in the visitor database is updated frequently. The corresponding customer record in the home database is also updated. Thus, the transmission and processing costs for maintaining the current location information in the home database will be significant, especially if the customer is located far away from the U.S. The situation will become even worse if the customer moves from location to location without making or receiving calls; i.e., no revenue is received to cover the cost incurred in handling the database updates.

Detailed Description Text (89) :

As a result, the home database does not need to update the location information every time a customer changes its location overseas. Furthermore, calls originated from the U.S., destined for a customer traveling overseas first retrieves the identifier from the home database and then accesses the current location information in the visitor database for call setup and other signaling functions.

Detailed Description Text (95) :

In accordance with the present invention, the extended signaling network based on replicated database has many benefits and can be viewed as a means to globalize the telephone network without actually building transport networks in foreign countries, which the telephone companies in the United States often are not allowed or prefer not to do. Yet, the replicated database design in effect makes use of foreign networks to support global mobility for network customers.

Detailed Description Text (97) :

The proposed design can also help the U.S. network compete with some foreign telephone companies. The network may choose to allow access to the visitor database only by (wired and wireless) networks of existing business partners; competitors' networks will not be provided with the signaling information stored and used in the visitor database.

Detailed Description Text (98) :

As a result, for calls originated in a foreign country and destined for a network roaming customer, only networks of the company in question are equipped to carry the calls. Such an arrangement can also be used to enhance the U.S. network's position in partnering with service providers overseas. In another business arrangement, the telephone network may also choose to furnish, for a fee, some foreign carriers with certain signaling information to carry calls destined for the network customers traveling in the country. Furthermore, if the telephone network can work with its business partners abroad, the replicated database design can be implemented in an alternative way.

Detailed Description Text (99) :

If an arrangement between the telephone network and its business partner overseas can be made, instead of installing network visitor database and STPs in a foreign country, records of network customers traveling in the country can be downloaded directly from the home database to a database in the partner's network. Consequently, as in the original replicated database design, each traveling customer continues to have two copies of his or her information for signaling purposes. The protocols and operations for the replicated design remain applicable to this new setting, although a United States telecommunications network does not physically own visitor databases and STPs in that country.

Detailed Description Paragraph Table (1) :

begin Access R.sub.A (vn.sub.-- late); (\*Access to the latest version of record A at the site\*) Record the VN, vn.sub.-- late, for the call; CC(vn.sub.-- late) .rarw. CC(vn.sub.-- late)+1 end else begin Access R.sub.A (n) that has been accessed by previous queries of the call; If the query is the last one of the call, then begin CC(n) .rarw. CC(n)-1; If CC(n)=0 and vn.sub.-- late>n, then R.sub.A (n) is deleted end end

Other Reference Publication (7) :

"Call Delivery To Portable Telephones Away From Home Using The Local Exchange Network", Beller, M., IEEE, pp. 948-953, 1991.

## CLAIMS:

1. A method for updating a replicated database in a foreign telecommunication network system situated in a foreign region and a home country telecommunication network system situated in a home country so as to improve call setup time and system availability in a foreign region for customers roaming outside of their home country comprising the steps of

updating a customer database record in a visitor database contained in a foreign region within a signaling system of a foreign telecommunication network situated in the foreign region, wherein the foreign telecommunication network includes a call transport system with switches for forwarding calls from a local foreign station through the call transport system to a destination,

transmitting information concerning the updated database record from the visitor database through a signaling system of a home telecommunication network to a home database located in the home country which contains a replicated version of the database record in the visitor database,

adding a field to the database record corresponding to a version number of the database record so as to identify the version of the database record referred by queries of calls in progress,

changing the home database record to reflect changes in the visitor database by using the version number sequence, while maintaining at all database sites an older version of the database record for query access until after completing the processing of all previous calls querying the older version of the database record, and

directing the query to the home database for accessing the customer database record if the customer is not roaming in a foreign region.

9. The method according to claim 1 including maintaining multiple versions of the database records in the home and visitor databases so that queries for a call can access the same version of the database record in the same database for consistent routing and signaling information.

10. The method according to claim 1 including deleting the older version of the database record at all database sites after completing the processing of all calls querying the older version of the database record.

11. The method according to claim 1 including adding a call counter field to the database record to indicate the number of ongoing calls whose queries have previously

accessed that version of the database record.

13. The method according to claim 12 including deleting the older version of the database record when the value in the call counter field is zero.

15. The method according to claim 1 wherein the call transport system of the foreign region includes a wireless phone network and a wired phone network.

16. A system for updating a replicated database in a foreign telecommunication network system situated in a foreign region and a home country telecommunication network system situated in a home country so as to improve call setup time and system availability in a foreign region for customers roaming outside their home country comprising

a foreign telecommunication system situated in a foreign region and having a call transport system and switches for forwarding calls from a telecommunication station through the call transport system to a destination,

a signaling system operatively connected to the foreign call transport system, and including a visitor database within the signaling system containing customer database records for call routing and other signaling functions,

a home telecommunication system having a home signaling system and a home database, said visitor database being connected to said home signaling system,

means for updating a customer database record in the visitor database,

means for transmitting information concerning the updated database record through the home signaling network to the home database containing an older version of the database record,

means responsive to the completion of all calls querying the older version of both the visitor and home database record for deleting the older version of the database record, and

wherein each updated record includes a call counter field for indicating the number of ongoing calls whose queries have previously accessed that version of the database record.

17. The system according to claim 16 including means for launching queries to the home database when calls are originated from the home country to a customer in the foreign region.

21. The system according to claim 16 including means for sending an acknowledgement from the home database to the visitor database after an updated database record has been processed within the home database.

22. The system according to claim 16 including means for maintaining multiple versions of database records in the visitor and home databases so that queries for a call can access the same version of the database record in the same database for consistent routing and signaling information.

23. The system according to claim 16 wherein each updated database record includes an identifying field corresponding to a version number of the database record so as to identify the database record referenced by queries of calls in progress.

24. The system according to claim 23 including means for updating the database records in the home database by the version number sequence of the updated database records.

26. The system according to claim 25 including means for deleting the older version of the database record when the value in the call counter field is zero.

27. The system according to claim 16 wherein said call transport system of the foreign region includes a wireless phone network and a wired phone network.

**WEST**

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 Generate Collection 

L17: Entry 2 of 263

File: USPT

Nov 27, 2001

DOCUMENT-IDENTIFIER: US 6324404 B1

TITLE: Cellular telephone system that uses position of a mobile unit to make call management decisions

DATE FILED (1):  
19960321Brief Summary Text (6):

The telephone unit includes a handset 4 having a keypad 5 as well as a speaker 6 and a microphone 7. A transceiver 8, ordinarily built into the telephone unit, exchanges signals via an antenna 10 with a mobile telecommunications switching office or MTSO 12 via a cell site 14. A duplexer 15 connects the antenna to the transceiver. The cell site 14 includes an antenna 16 connected to a control terminal 17 via a transceiver 18. The cell site 14 is connected to the MTSO via a transmission link 20. The Mobile Telephone Switching Office has historically been known as the center of the wireless over-the-air communications system. It is where the communication process management decisions are made, billing records are produced and where maintenance activities are initiated for wireless over-the-air communications systems. The MTSO is not a specific piece of equipment, but is comprised of many individual pieces. The MTSO will contain a telephone switch, peripheral processors, adjunct processors, and various other information gathering equipment used in the operation and management of a wireless over-the-air communications system. Each of the different pieces of equipment may directly or indirectly be involved providing the highest quality connection possible. The makeup of the MTSO therefore comprises many different pieces of equipment and many components, which can be supplied by different vendors. Therefore, communication process management decisions made at the MTSO can actually be made outside of a switch and can be made in a cluster of nodes housed along the network or even in separate cell sites. Therefore, as used herein the term MTSO really refers to all of the systems, nodes, modules, equipment and components that combine to define a wireless over-the-air communication process management network, regardless of the physical or system location of these elements. The term MTSO therefore is not intended to be limiting to the "switching off ice" as it may have been viewed in the prior art. The term is intended to be much broader than that and to include any combinations of equipment, etc that may be connected within the communication processing network of the service provider. The term MTSO is one of convenience and is intended to include all the information processing hardware and software associated with the wireless over-the-air communication process management process within a wireless over-the-air system, no matter where the hardware or software is located in the system. It is also noted that the term "intrasystem" refers to actions and components within a particular system; whereas, the term "intersystem" refers to actions and components located outside a particular system.

Brief Summary Text (7):

Referring to FIGS. 1 and 2, the operation of the CMR can be understood. The mobile unit M moves about the geographic areas covered by the various cells. As that mobile unit moves about, it decodes the overhead message control signals generated by various cell site control channels. The mobile unit locks onto the cell site that is emitting the strongest signal. The mobile unit rescans channels periodically to update its status. If, for example, a fixed-position land-based telephone T is used to call the mobile unit, a signal is sent via landlines L, to the central office CO of a public/switched telephone system (PTSN) 12A. This system then utilizes the switching network SN associated therewith to call the MTSO 12 via a transmission link L1. The MTSO then utilizes its own switching network and generates a page request signal to

cell sites via transmission links, such as the transmission link 20. The cell site which has been notified of the presence of the mobile unit M sends a signal back to the MTSO via the landlines or wireless links alerting the MTSO of the presence of the mobile unit. The MTSO then orders the mobile unit, via the notifying cell site, to tune to an assigned channel and receive the communication process.

Brief Summary Text (54):

The handoff process is similar to the present handoff processes, except it will be controlled according to position of the mobile unit instead of signal strength. This position information is used to determine communication process rating and taxing for billing purposes and communication process routing to make sure that the proper services for that location are provided.

Detailed Description Text (4):

If a Communication Process (CP) were initiated then the registration process, block 106, FIG. 9, would take place to update the exact geographic location (EGL). Once the exact geographic location (EGL) is established the routing selection for the Communication Process (CP) is begun, block 107. FIG. 9B shows that the first step is to identify the Communications Device (CD), block 401 so that the service characteristics, block 402 can be identified. A determination is then made as to whether or not service is to be provided, block 403. If service is to be provided proper routing is selected, with the most appropriate communications path to connect point A to point B is selected for the specific communication process based on the exact geographic location (EGL) of the Communications Device (CD), block 404. This may include activities and decision to route communication processes through land based networks, microwave, fiberoptic links and the like to allow for cost effective or expeditious connections to be established. If service is to be denied, the wireless communication system can direct the communication process to the appropriate announcement, block 405 and if the Communication Process (CP) being initiated is determined not to be a 911 emergency call, block 406. If a communication process is determined to be a 911 emergency call, then the system identifies the proper routing of the emergency communication process, blocks 407, 408 and 409, and the communication process will be directed to the proper emergency response system. The routing of this emergency call should be accompanied by all of the information that is pertinent and available, blocks 410 and 411. If the exact geographic location (EGL) continues to change, updates should be sent to the serving emergency response system, block 412. If another emergency response system needs to gain control of the call, the system will be able to establish a connection with the new emergency response system, block 413. This event is then recorded upon completion, block 414.

Detailed Description Text (5):

With communications established (FIG. 8), block 108, the exact geographic location (EGL) may be stored for Communication Process (CP) management, billing purposes, and other identification needs, block 114. The stored exact geographic location (EGL) is then recorded for establishing the origination point for billing purposes, block 109, emergency 911 call accounting, block 110, taxing purposes, block 111, rating the Communication Process (CP), block 112, or post communication process subscriber service, block 113. The Communication Process (CP) rating process shown in FIG. 9A identifies the subscriber characteristics, blocks 301 and 302. The recorded exact geographic location (EGL) is then compared to the Communication Process (CP) rating table, blocks 303 and 304 to select the correct rating, block 305 for that communication process (CP). This information is then recorded for later processing which may include application of taxes, Communication Process (CP) billing rates, or any other information which could be matched to the exact geographic location (EGL) of the communication process (CP). As the Communication Process (CP) continues, the exact geographic location (EGL) is constantly updated, block 115 or alternately updated at various intervals, block 114a, which intervals can be changed based on the time and/or distance traveled by the mobile unit to meet system needs for efficient communication process management, and these updated Communications Device (CD) locations are used for Communication Process (CP) management, block 116, billing decisions, block 119, and other real time processing uses, such as 911 emergency calls made while a non-emergency communication process was in progress, block 120, taxing, block 121, Communication Process (CP) rating, block 122, subscriber service, block 123, and frequency selection, block 124. The intervals at which the updating occurs can be determined on a preset time, such as every minute, or can be determined according to

distance traveled by the mobile unit, such as every twenty miles, or the interval can be set according to the nearest border so that the mobile unit will be monitored whenever it reaches a location that would cross over the border if the mobile unit traveled toward that border. In this manner, the billing information, the tax information and the frequency of the communication process can be based on the location of the communication process origination, but can also be continuously updated and changed as the mobile unit moves during the communication process whereby the exact rates and frequencies at any instant during the communication process can be applied to the communication process. As was discussed above, this will even permit separate networks to share cell sites as even though a single cell site handles a communication process, the location of the mobile unit will determine which system receives credit for the communication process and will handle the billing and taxing of the communication process. Alternatively, this will permit separate cellular systems to locate their own cell sites within the geographic area of another cellular system, and may even permit several different systems to share a single cell site.

Detailed Description Text (8) :

FIG. 10 shows how the billing information is passed along through an external billing system. The MTSO first generates Automatic Message Accounting (AMA) files, usually in magnetic tape format, which holds all the detailed records for communication processes processed from a particular MTSO during that billing period. The AMA records are then processed (formatted into database readable media) at the wireless communication system's billing center which emerge as Call Detail Records (CDR). Call Detail Records are the detailed accounting of all the communication processes assigned to a subscriber's account. The roaming and home reports are combined which are then processed as subscriber bills. It is here in the prior art system that any taxes may be applied by the service provider or by the wireless communication system. Ideally, taxes should be assessed based on the location of the mobile unit when service is provided. This is not the case with prior art systems. For example, home communication processes are taxed according to either the billing address of the subscriber or the zip code or business address of the service provider and roam communication processes, that is communication processes made using a cell site that is not in the mobile unit's home area, are taxed based on the billing address of the roam network or where the cell site is located that services the communication process. Any tax based on the cell site location has the possibility of being in error, especially if the cell site is located adjacent to a border. The prior art has failed to teach the distinction between fixed location of hardware and exact geographic location (EGL) of the Communications Device (CD) for billing.

Detailed Description Text (9) :

In the present system, the wireless communication system will obtain the instant location of the Communications Device (CD) at the registration process (FIG. 9). In a system where bills are processed externally, billing information combined with the location of on the Call Detail Records can then be compared to lookup tables or algorithms that will assess the proper tax or billing rate depending on the location (origination, termination, duration, instantaneous location, or the like) of the communication process.

Detailed Description Text (19) :

Still another application for the technology of this invention could encompass the switching of a dual frequency phone to a second frequency based on exact geographic location (EGL) of the communication device (CD). An example of this would be switching from 800-900 MHz to 2 GHz frequencies used in the upcoming PCS system. This would be useful for the commuter who wants PCS for his Communications Device (CD) in the city and to be able to roam out of PCS territory into cellular territory. It may even come to the time when subscribers are given rate plans that correspond to different zones, such as a 2000 foot perimeter of their residence which would be billed at a residence rate, and be billed at a Home market rate beyond that. Still further, when the subscriber enters into the geographic zone of his or her employer, the MTSO will forward his business communication processes to his communication device (CD), all based on his present exact geographic location. This could be an important competitive advantage to a service provider that owned the 900 MHz in one area and the 2000 MHz rights in a second area. For example, FIG. 16 shows service provider A, which owns the license to 2000 MHz in territory 1, the 900 MHz license in territory 2 and the 2000 MHz license in territory 3. When mobile unit CDX travels on roadway XR, it will pass

through all through all three territories. The service provider would like to handle all the billing revenue for its subscribers travelling through territory 2, but does not have the 2000 MHz license in that area. The communication device CDX is therefore instructed to retune to 900 MHz in territory 2 because System A does have rights to communication processes in territory 2 at the 900 MHz frequency. This allows System A to by pass System B even though the System B is a 2000 Mhz service provider adjacent to two System A territories.

**CLAIMS:**

29. The wireless over-the-air communications system defined in claim 28 wherein the means for making call management decisions includes means for updating billing information as the mobile unit moves during a communication process.